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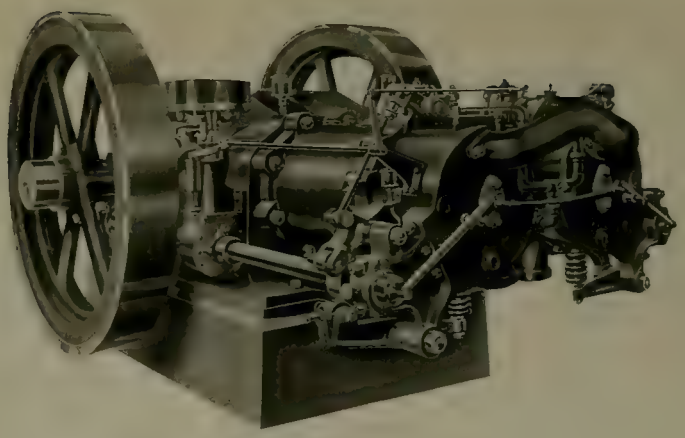
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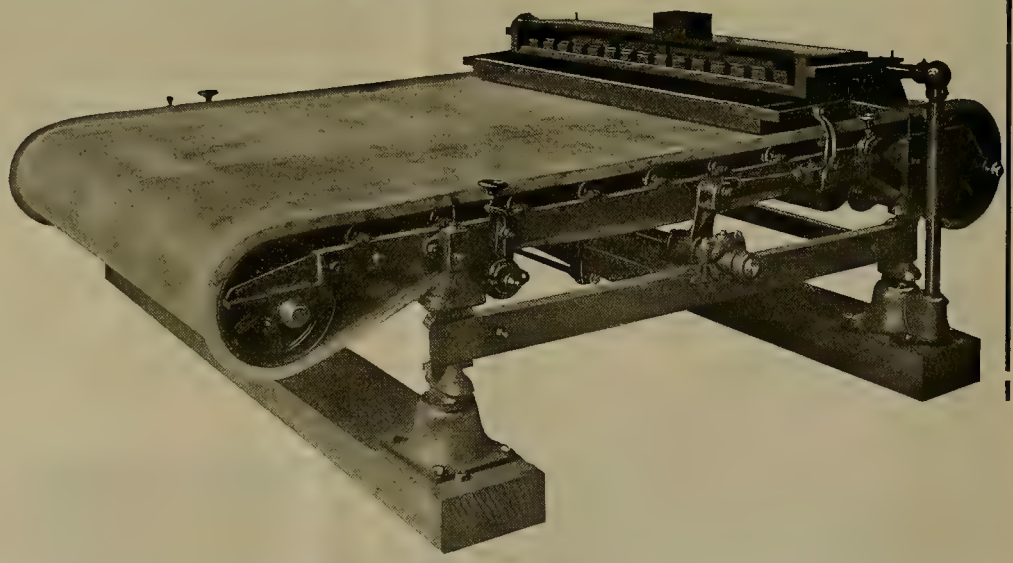
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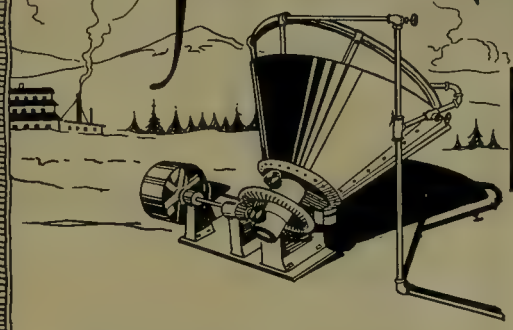
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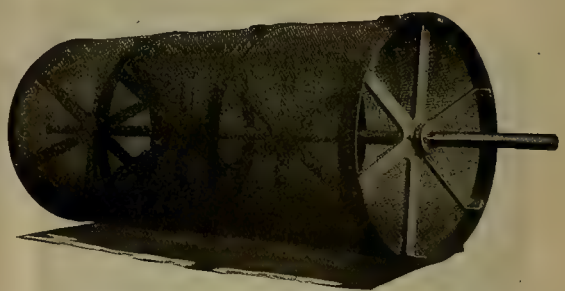
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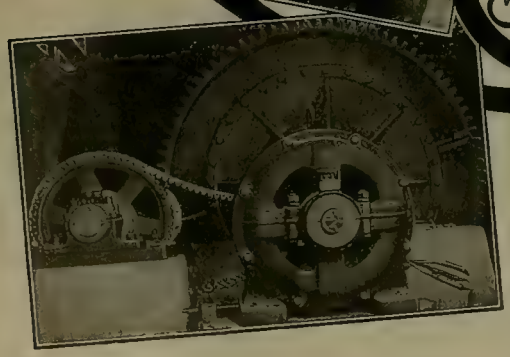
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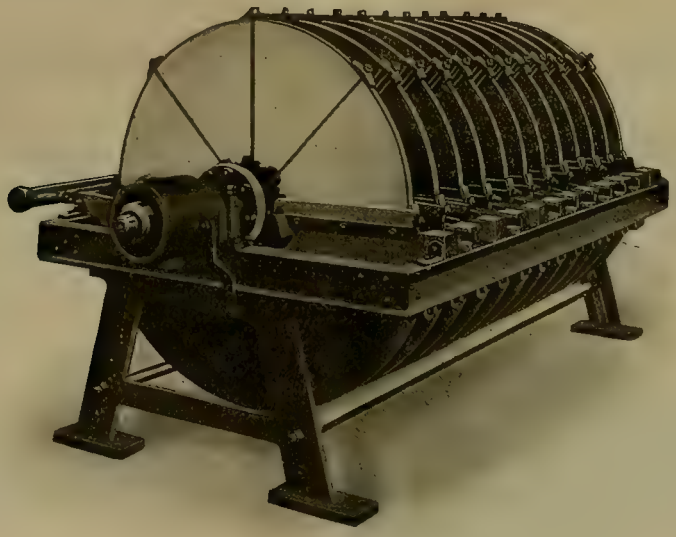
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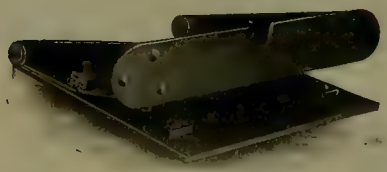


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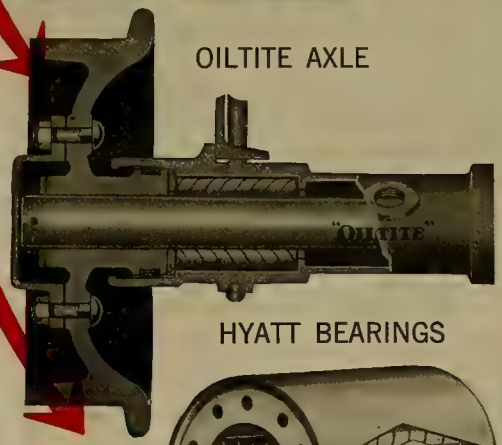
exclusive features HENDY-MADE cars OTHERS

DUST-PROOF AXLE



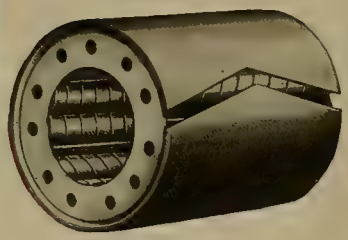
The axle consists of a dust proof housing which is bolted to the frame with bolts. Inside the steel 'live' axle in two pieces, that short-rad curves may be negotiated with ea Both wheel and axles are free to revolve, yet ne er can come off unless desired.

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This is the last word in car-axles. As shown, he working parts are entirely enclosed, no dust r grit can get in, and no lubricant can get out. It use makes a marvelously easy running car, and is practically trouble proof.

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To Users of the Callow Pneumatic Flotation-Cell

Users of the Callow Cell are naturally interested in knowing how the decision of the United States Circuit Court of Appeals for the Third District, in the Miami case, will affect their interests.

As we understand the prevailing opinion of Judge Woolley in the Miami case, he has interpreted the Supreme Court decision in the Hyde case as meaning that **"invention resides not alone in the critical proportion of oil, but also in air and agitation"**, and again, **"in the co-action of the critical proportion of oil and air affected by 'an agitation greater than, and different from that which had been resorted to before', resulting in a froth concentrate of economical value"**, and further, that the Supreme Court did not limit the patent to **"agitation by mechanical means"**, but to agitation of a violent and persistent kind; **"it mixes the oil with the metal of the ore. This is old. Then, by its greater intensity and longer duration, it stirs the pulp into a froth".**

Thus, this decision of the Third Circuit Court of Appeals has a most important bearing upon the art, because it holds that the mixing of the oil with the mineral is old, but it *leaves open the use of oil in connection with aeration-cells.* Meanwhile the idea of a 'critical' proportion of oil has been disproved by practice in several mills within a short time after it was promulgated.

Judge Woolley says further, concerning the Callow Cell: **"Aeration is direct, and is not the result of or caused by agitation. On the contrary, agitation results from aeration and such agitation, though present in some measure, is not even approximately of the violence and duration of the agitation of the patent. The operation in the Callow Cell certainly possesses these distinguishing features from operation of the process where aeration is caused by agitation".**

The Court further confirms this important dictum by saying: **"If the only agitation to which the pulp was subjected (after such agitation as in the prior art was necessary to mix the oil and ore) was the agitation of the Callow Cells, we would not say that that agitation amounted to or was the equivalent of the violent agitation of the patent disclosure and constituted infringement".**

Apparently users of the Callow Cell may feel assured they do not infringe the method of agitation described in U. S. Patent No. 835,120 (less than 1% oil), No. 962,678 (soluble frothing agents), No. 1,099,699 (phenol or cresol in the cold without acid) since all three of the patents are of the same process, dependent upon a certain degree of violence and length of agitation and the production of the same characteristic froth, as set forth in their claims.

[Signed] J. M. CALLOW.

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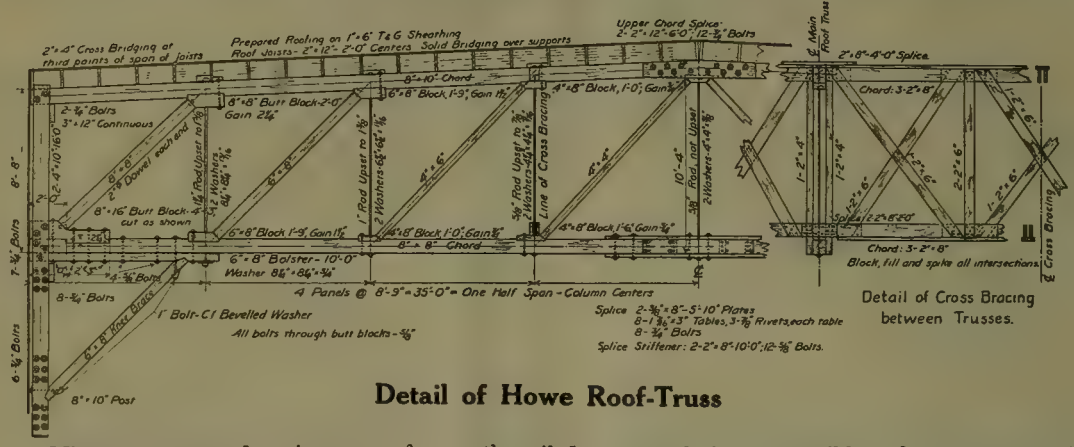
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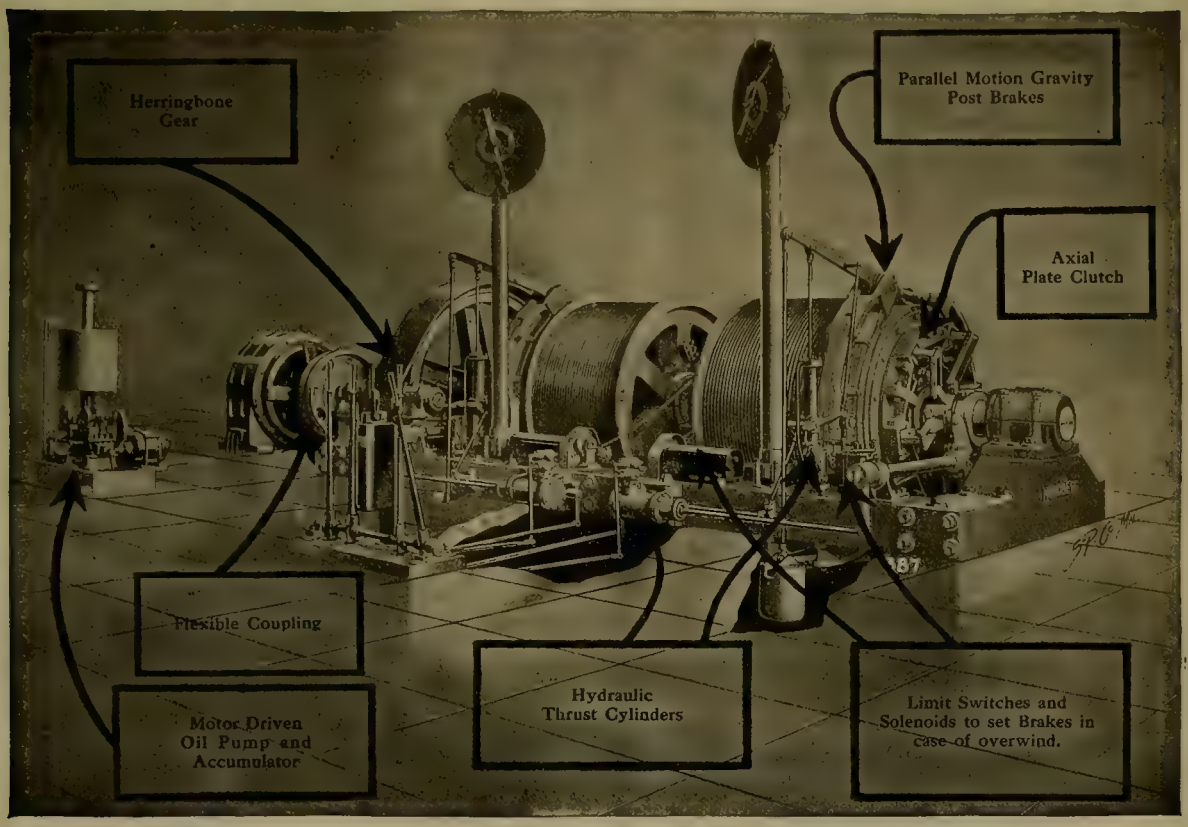
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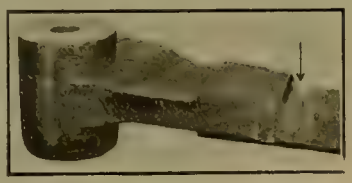
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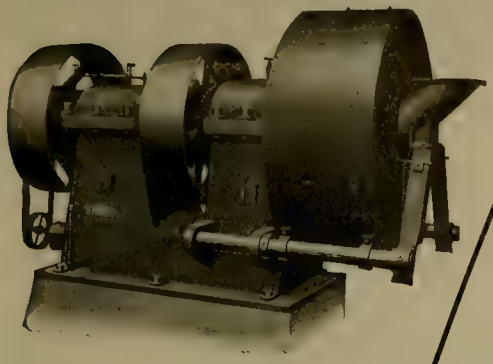
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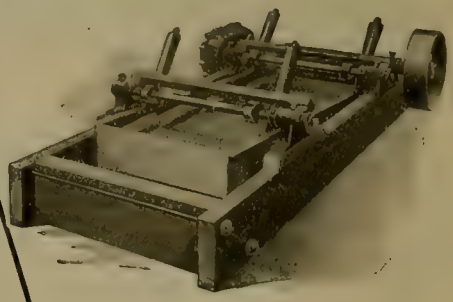
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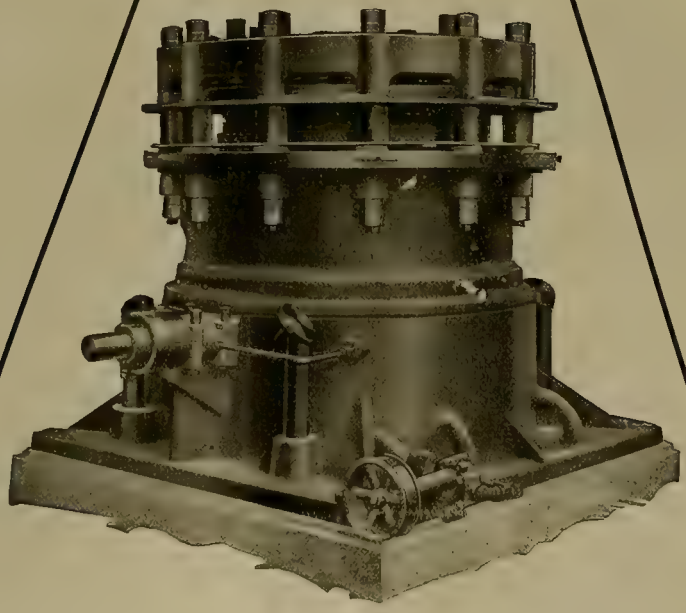
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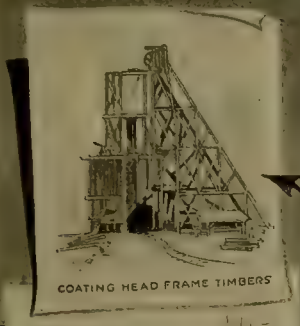
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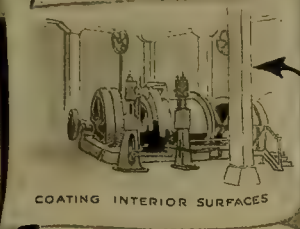
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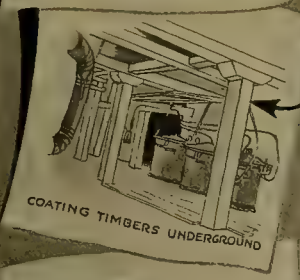
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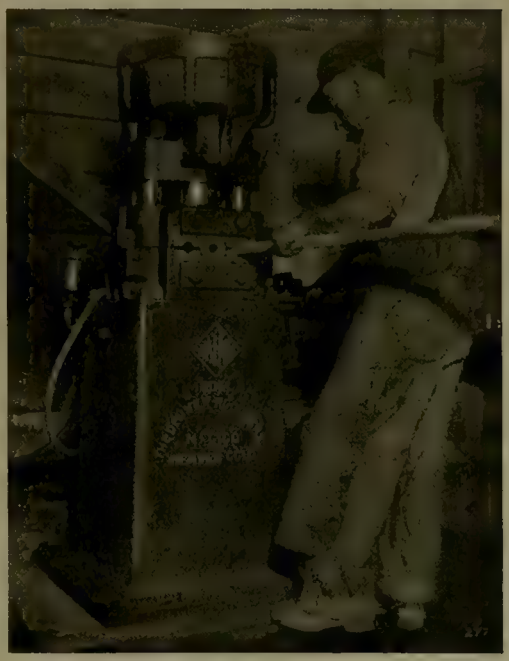
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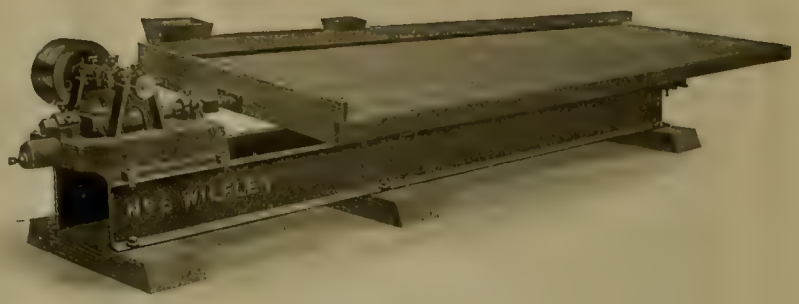
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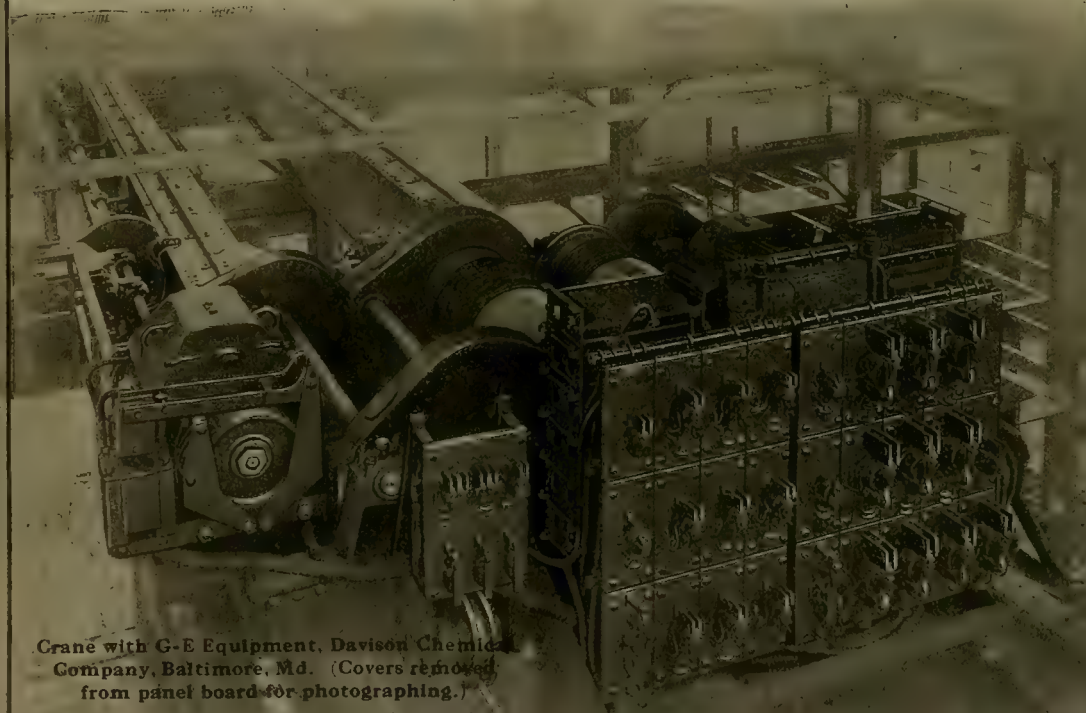
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6876



EDITORIAL

THAT grand old mine, the St. John del Rey, in Brazil, is still vigorous. It is the deepest gold mine in the world, the lowest level being 6066 ft. below the surface. Last year this venerable enterprise yielded a profit of $335,000, from the treatment of 94,300 tons, averaging $12.50 per ton.

NERO fiddled while Rome was burning and lives in history as the type of the heedless spectator of a great event. So today, while civilization is sent to the shambles and nations fight for existence, there are people that enjoy dog shows and cat shows, and there are newspapers that think to find interesting copy in such silly performances.

GOLD production in South Africa is suffering from labor shortage. The output of the Rand for 1917 is about $1,000,000 less than in 1916, Rhodesia and Australia show a decided decrease, while India and West Africa are holding their own fairly well. On the whole, despite the difficulties created by the War, the output of gold in the British dominions is being maintained at a high level, but no new and important discoveries have been made of late.

DIVIDENDS paid by copper companies during 1917 are estimated at $179,000,000 as against $157,000,000 in 1916, although the average price of copper was slightly lower. The fixation of the price at 23½ cents caused many reductions in dividends during the last quarter of the year. The Utah Copper heads the list with a disbursement of $23,555,105 to its shareholders, as against $19,493,880 in 1916. The Anaconda paid $19,815,625, and the Kennecott $15,832,194. Among the young producers the Inspiration paid $9,751,228, the Miami $6,537,360, and the United Verde Extension $2,992,500. The prospect for 1918 is prosperity, but with less lavish distribution of profit.

ANOTHER highly successful amateur golf tournament is reported from Del Monte. Any man that has the spare time and the physical fitness to play championship golf ought to be serving in the Army or Navy. Such public exhibitions of detachment from the War justify the statement, made by the editor of the 'National Service' magazine, that "we are fighting, compared with the other great fighters, approximately a 20% war, in the sense that compared with them we are using but 20% of available resources." By such slacking we face the danger of our failure to end the War, the possibility of such indecisive fighting as will prolong the calamity and increase needlessly our sacrifice of men and material. Let us put aside dog-shows, symphony concerts, and golf tournaments until we have seen this thing through.

ON another page we publish an article concerning industrial conditions by Mr. Charles T. Hutchinson, the manager of the business department of this paper. It is timely and written in a style that will be refreshing to the readers of technical descriptions. Mr. Hutchinson dwells upon the function of advertising and the purpose of such a periodical as ours, which, of course, is to furnish reading matter to those that buy, or direct the buying, of the manufacturers advertised through our medium of publicity. Fortunately those whom we aim to interest are more than commercial agents, they happen to be engineers and captains of industry, constituting a public whom any editor might be glad to address. The realization of that fact harmonizes the commercial and the idealistic elements into a task that lacks neither interest nor usefulness.

BUTTE has had an eventful year, as is shown in the review by Mr. Ben F. Evans appearing in this issue. Besides its copper, with which gold and silver are extracted as by-praducts, this district is now yielding manganese, so urgently needed in steel-making. We publish a short article on this phase of the local industry. We note with pleasure that the general search for manganese is proving successful, for the U. S. Geological Survey reports that during the first nine months of 1917 the production of first-class ore was 70,225 tons, by 88 operators, as against 26,997 tons, by 55 operators, during the whole of 1916. It is estimated that the total output for 1917 will be 122,275 tons, and that in the current year shipments may increase to 200,000 tons. The States prominent in this good work are Montana, Arizona, California, Utah, and Nevada. In our issue of November 17 we gave details concerning the manganese deposits of Philipsburg, Montana, and in that of November 24 simi-

lar notes concerning the manganese resources of Leadville, Colorado.

THAT the lack of developed mines in the Argentine republic is due to ill-conceived mining laws that fail to stimulate prospecting and exploitation is a statement of great significance coming, as it does, from Mr. Horace V. Winchell, one of the world's foremost economic geologists. In his letter on 'Mining Laws for Russia,'' published in this issue, he affirms that the eastern slope of the Andes, lying within Argentine territory, contains mineral resources as great as those in Chile. The liberal policy toward mines on the part of Chile is credited with being the chief cause for the great expansion that has resulted in stimulating her output of mineral products until they now reach a value of $140,000,000 per year. The contrast between this and the paltry sum of $300,000, which represents the yearly total of the Argentine output, should arouse to action the president of that republic, Hipolito Irigoyen, a man of practical sense, whatever we may think of his politics. He is not likely to overlook an opportunity for the improvement of his country when the proper course is made convincingly clear to him. For the sake of any who may be inclined to let the bad impressions created by Mexico influence their opinions of her well-behaved sisters in South America, we may point out that the Argentine government, to all appearances, has become as stable as our own. That involves progress in the arts and in the making of rational laws. The criticism offered by Mr. Winchell does not mean that the Argentine government is illiberal and restrictive in the sense applicable to recent Mexican legislation; it means merely that a great pastoral and agricultural people, blessed with rich pampas lying close to the sea, while their minerals are hidden in the remote western mountains, necessarily developed first the accessible riches, and that they have not awakened to the reality of the opportunities for the production of metals. The same course of tardy development characterized the United States. Prior to 1866 there was no Federal mining law on our statute books, and the one adopted in that year was slipped through Congress as a rider on a ditch-law. It is interesting to be assured, by so trustworthy an authority as Mr. Winchell, of the existence of these virgin resources in a country that has passed through the revolutionary measles and whooping-cough to mature healthiness. Favorable legislation will unlock the Argentine treasures in due season.

RUSSIA will need a stable government before any mining laws can be effective. Mr. Winchell's recommendations were made when the Kerensky administration was in the saddle and, it was hoped, so firmly as to be able to ride the storm of revolution. We have not always agreed with Mr. Winchell as to the advisability or otherwise of changing our own mining laws, but that does not prove necessarily that his ideas are wrong. What he says to the Ministry of Commerce at Petrograd concerning the American law of mining is well expressed and to the point. His suggestions are wise, particularly as to the need for simplicity and uniformity in the proposed regulations; also for the withholding of mineral land from persons or corporations unable or unwilling to develop them, that is, to discourage the speculative holding, or 'shepherding' of claims, as they call it in Australia. Likewise he places emphasis on the desirability of free markets and the absence of vexatious restrictions to operation. He refers to the regulation compelling foreign companies to employ Russian engineers as managers. This has proved a hindrance, rather than a help, in most cases, causing a duplication and conflict of management not at all favorable to profitable enterprise. It would be better to leave the engagement of Russian engineers to the discretion of the operating companies, which would find it useful, in more senses than one, to employ some of the many capable technical men now available among the Russians themselves, but the delegation of supreme local authority to a person nominated by anybody but the board of directors only works for trouble. This has been one of the drawbacks to operating in Russia, and we hope to see it adjusted in a friendly manner for the benefit of all concerned. Meanwhile the many capitalists and engineers interested in Russian mining, and anxious to participate in the exploitation of Russian mineral resources, must possess their souls in patience. No business is possible until sane government has been restored.

ON another page we publish a review of operations during the fourth quarter of the past year in the zinc-lead region that extends over parts of Kansas, Oklahoma, and Missouri, to which we have ventured to give the name of Komspelter. Whether this convenient name will prove acceptable to those most nearly concerned, we do not know yet. It will be noted that the mining of zinc deposits, containing lead in proportions varying from a mere impurity to an important by-product, has spread south-westward from Joplin to Picher, and then nearly northward to Crestline, transgressing the borders of three States. Our correspondent, Mr. Otto Ruhl, has long been identified with the Joplin mining industry and is especially qualified to write on the important developments in that part of the country. He will not be offended if we mention the fact that we had to correct his use of the term 'ore' in order not to confuse those of our readers that are unfamiliar with the local terminology. It is the custom at Joplin and its tributary mining communities to use the word 'ore' to signify 'concentrate,' although the same word is also applied to mill-feed or crude ore as it comes from the mine. The significant quotation on the local market is the price for 'ore,' which means a concentrate containing 60% zinc. Other local terms include 'dirt' for mill-feed and 'chats' for a jig-product that needs re-grinding to liberate particles of blende. To these there is less objection because at least they will not be taken to signify something quite different, but to speak of a concentrate as 'ore' is

about as silly as the custom, in Gilpin county, Colorado, of giving the name of 'tailings' to the pyritic concentrate sent from the mill to the smelter, or the Lake Superior habit of calling copper ore 'rock.' The use of such self-contradictory terms may not confuse residents in the district, but it makes for confusion when they undertake to give information to those outside, and it is objectionable in a broadly basic way because it stultifies the language of technology. Now that the zinc region—not 'district'—of Komspelter is attracting the attention of operators and engineers all over the country, it would be well to use terms that everybody will understand.

Peace Talk

The new year opens with talk of peace sufficiently serious to test the morale of the Allies. The idea of peace is heavenly. None but a criminal lunatic would wish to prolong the War by one day, provided the purpose of our fighting were fulfilled. That proviso is the crux of the matter. Our purpose is to check the military aggression of a government and a people that have gone mad in an intensive effort to dominate the world and that, in making the effort, have reverted to methods of warfare that shame civilization. We fight to restore the world to sanity and orderly living; that can be assured only when the aggressor is defeated and so hurt by his attempt that he never will be able to make another effort of the same kind. This War is a pitiful tragedy, but there is a worse possible, namely, that the War shall have been in vain, that thousands of young lives shall have been sacrificed only to give Germany an interval of recuperation for another preparation before she tries again to do what she nearly succeeded in doing the first time. There must be no second time. The three years of the present struggle have seen the invention and development of death-dealing instruments and methods at a rate so rapid as to indicate that if the Prussian machine were granted twenty years of peace for a second preparation it could fashion weapons of war that would simply blight the earth like a collision with a comet. The present calamity must be the means of preventing a greater catastrophe. If we endure the horrors of this war, with all its calls for sacrifice of life and happiness, if we face a continuance of the bitter struggle, it is with the determined purpose that this shall be the last of such wars. From the achievement of that purpose we shall not be diverted by the poisonous gas of German propaganda nor by the delirious drivel of the Russian anarchists. The horror of war is impressed upon us; we want to end it and to make the guilty breaker of the peace so sorry that he too will be deterred from another outbreak. Those that have seen the shambles of the battlefield and even those that have read the realistic descriptions, particularly by French writers, will be in agreement that to say that war is inevitable is to utter a blasphemy against the human spirit. It shall not be inevitable; it must be made impossible.

The Affairs of the Institute

An amendment to the constitution of the American Institute of Mining Engineers, with a view to a closer definition of the qualifications for membership, has been proposed and is now to be the subject of a vote. It has long been felt that the Institute suffered from including a number of persons to whom the terms 'engineer,' 'metallurgist,' or 'geologist' were not correctly applicable. This injured the status of the organization and diminished its professional solidarity. Therefore the proposed restrictions, all reasonable and moderate, will be welcomed. Besides restricting the election to membership it is proposed to create a class of 'associates,' to be qualified by "interest in, or connection with, mining, geology, metallurgy, or chemistry." This, at first sight, may seem to be so vague as to perpetuate the worst features of the nondescript membership to correct which the latest constitutional amendment has been proposed. The natural fear of a loyal member of the Institute would be that this 'associateship' may open the doors to non-professional persons without technical training and allied rather to the promotion of mining schemes than to the operation of mines. We understand, however, that this danger has not been overlooked, and that ample protection against it is assured by the scrutiny to which every candidate's name is exposed by the Committee on Membership, a committee that is doing yeoman service. The aim is to make the Institute thoroughly representative of all the respectable and worthy elements in the diverse personnel of the mining industry and yet to restrict full membership to those taking a responsible part in its technical work. This it is expected to accomplish satisfactorily by having both 'associates' and 'members.' During the last five years the additions to membership have been 433, 921, 553, 750, and 1005, the last figure, however, not including any elected after December 15, 1917. Thus 3662 have joined the Institute in the five years, proving the vitality of the organization and the energy of the Membership Committee, the chairman of which is our former associate, Mr. Thomas T. Read. The big gain has been made, with few exceptions, without lowering the standard of past membership. Nor do we see any immediate danger of lowering that average, even after the class of 'associates' has been created, because as much care will be taken in electing the latter as was taken formerly—say, ten years ago—in the election to full membership. The only danger we can see, as a consequence of a big addition of names, is that of straining the finances of the Institute by the publication of papers and volumes that cost more than the annual dues. Less quantity and better quality, a smaller mass of material and closer editing, are needed; and these we shall expect now that Mr. E. K. Judd has been appointed editor of the Transactions. On the whole, even a somewhat detached critic must allow that the management of the Institute during recent years has been such as to inspire confidence.

A Nationalized Railway System

President Wilson has followed the recommendation made by the Federal Trade Commission last June in taking the railroads under Government control. The suggestion at that time was regarded in some quarters, particularly in railroad quarters, as premature. No careful observer could fail to be struck with the fact that a great and peculiar hush fell upon the daily press of America so far as this topic was concerned immediately after the printing of the initial dispatch, which said simply that the Federal Trade Commission had formally advised Congress that the transportation systems of the country, by rail and by water, should be "pooled and operated on Government account, under the President, . . . as a unit, the owning corporations being paid a just and fair compensation." It will be seen how literally the President has carried out the plan advocated by this competent Commission to whom it had become clear, after less than three months of confusion following the declaration of war, that the common carriers, as then constituted, were unable to cope with the national crisis. The succeeding six months have added force to that conclusion. The nation has lost time in military preparation through lack of co-ordination in the transportation service, and the people at large have suffered extreme inconvenience and enormous increases in the costs of doing business over and above the rising prices produced by other economic difficulties. While efficiency would have been gained by prompt action last June, it must be conceded that the trial which is now to be made of Government administration of the railroads will meet with less hostile criticism in consequence of the opportunity given by the President to test the ability of the railroad managers to meet the crisis by themselves. Furthermore, Government aid was afforded them through a committee of practical railroad men whose purpose was to facilitate an effective co-operation under the system of private ownership and control, but in the end it became apparent to the whole country that the net result had been failure. The public therefore accepts the decision of the President with feelings of relief and confidence.

The significance of the step is enormous. Although not directly involving Government ownership it does mean the nationalization of the railway system, and many Congressmen have said that the continuance of Government control for all time depends entirely upon the success attending this experiment. If necessary for the welfare of the nation at a moment when inefficiency dare not be tolerated, it will be logical to ask why public business should be subjected again to demonstrated wastefulness and inefficiency in times of peace. If the War is to bring any great and lasting benefit it must be found in the amelioration of the conditions of human life, and the pivotal question around which revolve the social struggles that have disturbed the world since the growth of the factory system is that of reducing the hardships of gaining a proper livelihood. Economy in the distribution of commodities is of the utmost importance in planning to alleviate the burdens that press upon the people. In the first months after we entered the War it became evident that the two largest factors in the high cost of living were the evils of profiteering and the inefficiency of transportation. The Government unhesitatingly grappled with the first of these so as to inspire confidence that the middleman will be regulated within another year in such manner as to perform a useful function as a public servant; and now the solution of the transportation problem is undertaken by a masterstroke that promises long-needed relief. It is doubtful if the owners of railway stocks and bonds will consent to have their properties returned after the War to the control of financiers and speculators who would manipulate them for narrowly selfish purposes as they were accustomed to do in the past.

The ownership of nearly one-third of the railroads of the world has already been vested in the governments of the respective countries where they operate. In the British dominions 55% of the mileage is so controlled, and the entire 24,000 miles of railroad in Great Britain itself is temporarily and successfully administered by a Royal Commission. The action of President Wilson affects 265,218 miles of railroad in the United States, making a total of 502,228 out of a world-mileage of 713,120 now operated as public utilities. The time has gone when we need fear political graft and perfunctory service in the administration of nationally controlled enterprises. The Post-Office is a shining example of efficiency and economy. The Panama Canal has afforded another instructive object lesson, enlarging the confidence in Government ownership and control that had been created by such beneficent projects as that of the Sault Sainte Marie locks and canal, which have made possible the great expansion of our iron and steel industry. Government work today is conducted on business principles, for civil service reform has spoiled the larger opportunities for private graft. Railroad employees will pass under similar rules, affording them protection greater than any they can secure through the costly mechanism of labor organizations. They recognize already the advantages flowing from their new status as Government employees, in consequence of the announcement that the exorbitant salaries of the high officials are to be trimmed down, thus enabling higher remuneration to be offered to the humbler workers. It is evident that the salaries paid to senators, departmental heads, bureau chiefs, and other responsible officers of the Government, will constitute a measure of the stipend appropriate for the managers of the railroad system. It is perfectly understood that the princely rewards distributed among railway officials have been in recognition of special ability in aggressive competition, in financial manipulation, and in the control of politics and legislation, rather than for services in the routine of practical operation. Under Government control the need for such qualifications instantly

disappears, and incidently one cause of political corruption thereby will be eliminated. The great organizations maintained for the solicitation of patronage will now be unnecessary, and many of the minor competing lines can be consolidated, not only insuring better service, but relieving them from an unnecessary burden of administrative expense. The wastefulness of separate terminals will be greatly reduced; the luxurious and half-filled passenger trains will be adjusted to the actual needs of the traveling public; the tourist business, especially during the continuance of the War, will no longer embarrass more necessary service. Under the old system many of these extravagances were unavoidable. To a large extent the duplication of roads and terminals, and the consequent overhead cost, were the only means that offered escape from crushing monopoly. The profligacy of the system stands out in strong relief as soon as we contemplate a single national system operated for the welfare of the whole people. Major Smith W. Brookhart, one of the best-known railway statisticians in the country, recently estimated that Government ownership would save $400,000,000 per year through elimination of competitive waste, and $500,000,000 in interest upon funds required for betterment because of superior Government credit. Major Brookhart's figure for the saving to be made by abolishing competition is regarded as conservative. No less capable a witness than C. P. Huntington affirmed some years ago that the competitive waste in New York City alone amounted to $100,000,000 annually. It is likely that the consolidation now consummated will effect economies in excess of a billion dollars per year, quite apart from the advantages of effective assembly of military supplies and the cheaper and more systematic distribution of the necessaries of life throughout the United States. On the outbreak of hostilities in Europe the railroad managers, professing not to realize the inevitable expansion of business that would ensue, took a pessimistic view of the industrial future of the United States. At a moment when orders for equipment, barely adequate for the needs of normal traffic, might have been placed at most advantageous prices, they curtailed the outlay for maintenance and improvement. A few months later, when the flood of war-orders from England and France began to inundate our manufactories the railroads proved unequal to the task of handling the business successfully, and operating costs were increased by the necessity for ordering rolling-stock and other supplies at war-prices. Under Government control it would be possible to take advantage of periods of market depression to provide needed equipment, and this would act as a stabilizer of industrial conditions. Already the Administration has suggested the necessity for providing money to make good the shortage of rolling-stock. All the funds that are needed can be secured on guaranteed bonds at 4%, where privately owned roads would have to pay from 5 to 6%. Moreover, it is understood that the Government will seek authority to purchase such new securities, thereby becoming a creditor and looking toward permanent control of our national transportation system. The real owners of the railroads long have been the general public. They now find themselves protected as never before, through the Government guarantee of dividends based upon the average return for the last three years. The effect on the minds of the people has been registered by the sudden rise of quotations on railway stocks. No step that President Wilson has taken has met with more popular approval than the nationalization of the American railroads. It makes for unity of effort in winning the War, for higher efficiency in our whole industrial system, and for reduction in the cost of everything that enters into the life of the people.

Gold and Credit

Although the threat to discriminate against freightage for gold mines has been withdrawn, it will be well for every thoughtful citizen to be on his guard against an economic heresy that would do much worse than threaten the welfare of a part of our mining industry—it would endanger our solvency as a nation. The net gain of gold to the United States from August 1, 1914—the day the War began—to November 16, 1917, is stated officially to be $1,082,212,000. This gain is impressive, but it is small compared with the indebtedness being incurred at a growing rate by the Government for the purposes of the War. The expenditure in one year is twenty times as much as the value of the gold accumulated in three years. It is no wonder that the use of gold coins for Christmas presents was discouraged by those in authority nor that an embargo has been placed upon the export of this basic commodity. We must keep our gold where it can perform the greater service, and we should intensify the mining of the ore that will yield more of it. We shall need it, if we are to emerge financially safe out of the morass of international credits. The expansion of bank-credits caused by the flotation of huge government loans in Europe and in this country since the War began is tending to produce world-wide inflation, such inflation as is inevitable when a government borrows faster than its people are able to save. As Mr. Adolf C. Miller, of the Federal Reserve Board, has indicated, the rise in prices of all commodities is due to the fact that the purchasing media—bonds, notes, and other forms of credit—are being produced faster than the commodities themselves. "When the supply of currency and credit in its increase outruns the supply of purchasable goods, the price of goods must rise," says Mr. Miller. That is sound doctrine. Let us see now where it leads us. The normal, conservative, credit-expanding power of gold is usually taken at about the ratio of seven to one, that is, the gold reserve of the United States, now estimated at $3,089,000,000, is good for a volume of adequately secured commercial paper amounting to a little more than 21 billions of dollars. Moreover, the expansive power of the British gold reserve is also being utilized in this country through the fiscal agents of Great Britain, thus

adding to the volume of credits available, while exchange is protected through daily purchases of surplus bills drawn against London, thus stabilizing the value of the pound sterling. In effect, the British banking system has become unified with that of the United States, and other allied countries are doing the same. Accordingly no paralysis of credit is in sight at present, and our resources have not yet been over-strained. The available inter-allied credit-limit is not far short of 40 billions of dollars. On the other hand, the increase in the nominal value of commodities represents a shrinkage of purchasing power, so that the commodity-volume to which the expanded credits apply has actually cut our financial resources nearly in half, viewed with relation to supplying the needs of our own country and of our Allies. This explains what Mr. Miller meant when he pointed out the disproportionate increase of credit-paper over the corresponding actual volume of commodity-output. The ultimate effect would be disastrous were prices to fall at the end of the War. That would mean ruinous liquidation. Apparently the stability of business depends in no small degree upon maintaining the scale of prices and wages established under the stimulus of the wild speculation that followed the receipt of big war-orders from Europe in 1915 and 1916. Had our political leaders foreseen, as did a few of our broad-minded financiers and political economists, that this was our war from the moment when the Germans, frustrated at the Marne, began to dig themselves in for a long and stubborn contest, we would not have disturbed the financial structure of America and the world by proceeding to exploit the nations then involved in the struggle against Prussian aggression. The mob of commission men had much to do with adding to the enormous cost of supplies in the earlier period of the War, but, after this evil had been corrected in part, the manufacturers continued to quote prices out of reason, as the soaring quotations of industrial stocks accurately recorded at the time. It is not to be expected that the laboring man and the producer of raw materials will consent to receive the pay corresponding to periods of normal business when the evidence of profits that can multiply the value of stocks many times over is presented daily to him in the stock-exchange reports. Failure to realize our grave responsibility at the right moment, coupled with our persistence in squeezing the last dollar we could get from the nations that were then fighting the battles that protected us from the Prussian menace, has precipitated a new difficulty that calls for the wisest statesmanship and the soundest finance. Inflation of prices has resulted, and the world must not only adopt these fictitious values, but may need to maintain them for an indefinite period, in order to avert collapse. Our dollar is no longer the dollar of 1914; it is about 58 cents as compared with the purchasing power of the dollar of that period. The dollar of today is an altered monetary measure, and it will require more gold to cover the transactions of the future in equal quantities of wheat and corn and meat than it did in the past. To talk of restricting the accumulation of a gold reserve at a time when the purchasing power of the dollar has shrunk one-half is to limit the volume of credit to a point that will prove insufficient for the growth of commerce. Fortunately Great Britain and the United States have a corrective in their resources of gold-bearing ore. Between them they control directly 80% of the world's annual production of that metal, and indirectly at least 10% more. The gold production of the world is $450,000,000—not much in these days of billion-dollar loans, but enough to stiffen the base on which a vast system of credit is reared. Of the world's silver the British dominions produce 30,000,000 ounces and the United States 75,000,000 ounces, out of a world's total of 177,000,000. Indirectly the Allies control the output of at least 50,000,000 ounces more, so that 155,000,000 ounces, worth now about that many dollars, is available annually for maintaining the basis of credit. Thus the two English-speaking Allies, by their own mineral resources and the enterprise of their citizens in other regions, control 90% of the precious-metal production forming the hard bottom of international credit. The enemy countries—Germany and her vassals—cannot place their hands upon more than 2% of the gold and silver annually produced. This is a factor of prime importance at this juncture in the world's history. It represents a decisive economic advantage, if properly utilized. In conjunction with the reserves on hand, it constitutes an adequate foundation for a complete and well-balanced industrial organization, outside the confines of any Teutonic hegemony. We can suffer the Hun to rage within the barbed-wire entanglements that now fence about his empire of wrath. The nations outside possess nearly five-sixths of the total gold and silver that is so necessary for universal credit and exchange. This is exclusive of the reserves that the old regime left in the State Bank of Russia. Despite the improvident exaggeration of prices that was induced largely by a scramble for sudden wealth through war-contracts, and which, like a noxious germ, has developed its own toxin in the form of an attenuated dollar, the exterior nations are prepared, both industrially and financially, for continued growth as a world apart. Even the abstraction of materials for belligerent uses may not defeat the natural expansion of industry when it is considered that all elements are available, and in a quantity greater than served the needs of commerce before Germany and her *ames damnées* became barred from intercourse with the champions of freedom. Problems of extremest gravity, no doubt we have; conservative financiering must guide us in meeting the changed conditions brought on by top-heavy governmental burdens; but the spectacle of a world provided with all the essentials, so that the maintenance of commercial equilibrium does not require the Central Powers, is a pleasing thought as we step into the New Year. It suggests an adjustment between the free nations of the world that will ease the economic hardships that have been so pronounced at the beginning of the struggle.



Water in Stamp-Milling

The Editor:

Sir—There are many and varying factors that govern the ratio of water to ore in stamp-milling. Recently there came to my attention an example of present practice on the Mother Lode, California.

Crushing with 950-lb. stamps, through a 20-mesh screen, at 110 drops per minute, a 7½-in. drop, and a low discharge, the output per stamp is 7.5 tons per 24 hours. The ratio of water to ore is 2.4:1. The pulp flows over amalgamating plates having a fall of one inch to the foot, thence to tables.

One would expect with an output of 7.5 tons per stamp per 24 hours a water-ratio approximating 5 or 6 per ton of ore. Seeing a high crushing-duty was desired, the question naturally arises why so little water is employed, water being plentiful. It appears beyond controversy that, within limits, an increased water-supply gives an increased output, by liberating the particles when ground. Would an increase of water in this instance have added to the already high stamp-duty?

In modern milling practice, using coarse crushing, a water-ratio of at least 6:1 appears necessary to wash rapidly the coarser particles through the screen. I infer, therefore, since water is the vehicle of discharge, that coarse crushing requires a higher water-ratio than fine crushing. The point I wish to bring out is this: is not the tonnage crushed high relative to the water used, and would the output not be further increased by an addition of water?

Possibly other workers on the Mother Lode may afford further data.

H. E. WEST.

San Francisco, December 5.

Scotch Philosophy and the Lead-Smelters

The Editor:

Sir—The greatest glory of Scotland, one of the highest honors that could be possessed by any nation, is found in the achievements of those transcendent intellects which adorned and embellished her literature in the latter part of the 18th century. During that period there sprang forth from her bleak and misty hills upon an astonished world the amazing and comprehensive conceptions of Adam Smith, the clear and skeptical logic of Hume, the profound and far-reaching discoveries of Black. Adam Smith produced order from the chaos of the collective actions of men. His 'Wealth of Nations' and the ideas contained in that monumental work transformed the English policy of trade. Hume, with unparallelled lucidity, tore the mask from superstition and cant, and lastly Black made his generalizations on the existence and behavior of latent heat. Lesser lights in the constellation of Scottish greatness might be cited, but the object here is not to exalt Scotland, but to justify a system of thought that appears to have been transplanted to America, and to have further justified itself by success in American industrial fields, as well as in the Scotch philosophical world.

It is not my purpose to tire the reader with prolix philosophical distinctions between the various methods of reasoning. There are, however, two sharply defined systems of thought, one being known as the 'inductive' method, and the other as the 'deductive.' The inductive was, and probably is, the typical English method. In this system great stress was laid upon experimentation, and the proving of principles by a multitude of facts. The deductive method, on the other hand, by great flights of the imagination, established its principles and proceeded by 'deduction' to arrive at results without the laborious efforts required by the opposite system.

Perhaps no field of American industry displays a more profound knowledge, or greater skill in the application of the principles that underlaid the work of the Scotch philosophers, than the one occupied by the lead-smelters A thorough study of the typical settlement sheet displays an intricate—indeed, a dazzling and incomprehensible—knowledge of deductive methods. The men who outlined the process of ore-buying, of which a settlement sheet represents merely a summary, show a rare skill, which for general scope compares favorably with Adam Smith, and for finish and touch, was never excelled by the delicate efforts of Hume. An instance to the point is where the smelters make a deduction of 1% for moisture regardless of any efforts to prove inductively that it is there. In fact, the magnificent sweep of their intellects steps over the presence of such a small item. It is sufficient for these able men that they make a fitting and proper application of their basic principles.

Their next step is to ascertain what percentage of lead is contained in the ore. This they first firmly establish, ignoring the old fire-assay, which, of course, is low. By latter-day methods the amount of lead in the ore is determined. Once this point has been reached, deduction philosophically steps in and proves incontrovertibly that although the lead is not absent, neither is it all present, and no matter what is there, there are two units less

than whatever it may be. Thus is the antiquated fire-assay reconciled to its more modern successor by a clever adjustment of differences that, in the end, leaves everything pretty much as it was in the beginning, and obviates any confusion that might have resulted from the introduction of the later method.

The reader's attention should now be concentrated with particular intensity upon the next step. Here, unless great care be taken, one will be apt to jump to the conclusion that deductive methods are being ignored, as with apparent abandon they yield the seller 90% that may exist at this stage of the deductions. Reflection, however, will show that the smelter is entirely consistent and that a little thought on the part of the reader, without further argument, will prove that precisely the same result may be reached by deductively abstracting 10% from the amount existing at the stage marked by the beginning of this paragraph.

We now come to the master-stroke, the point where the deductive process becomes overwhelming to the mere miner. There is another fine touch here, a neat and clever distinction, and at bottom a profound appreciation of the difference between scientific and empirical knowledge. If lead is selling at five cents per pound, and the smelter usually determines whether it is or not, one and one-quarter cents is deducted presumably for shipping, refining, and selling expense. After the price has passed the five-cent mark, one-quarter of a cent is deducted for each cent paid over five cents. Now, without reflection, the average person will no doubt consider that the deduction before the five-cent price, and the deduction after the five-cent price were one and the same thing, and that after all a 25% deduction would attain the same result as the more complicated system. It is manifest, however, without recourse to any fine reasoning, that the cost of refining, shipping, and selling does not vary with the market-price of the lead, and that the smelters must be guaranteed a reasonable compensation for this service independent of the price of the product. Here for once we find a deduction that is not the result of deductive reasoning. It should be noted, nevertheless, that the deduction, although not deductive, cannot be said to be inductive, as the facts upon which this deduction has been based have not been established as actually existing. In other words, the smelter has not proved that the costs are actually one and one-quarter cents, but might be any figure, say one-half a cent, one cent, or even two and one-half cents. After the price has passed five cents, however, the smelters come again under the unrestricted sway of their deductive principles. One-quarter of a cent per pound here means 25% of the value of the lead, a splendid stroke as the most enthusiastic inductive philosopher would be obliged to admit.

For years the Americans have been branded as mere money-makers, dollar-chasers, and Mammon-worshippers. We were held up to view as a people glorying in vain shows of power and wealth, sensual ambitions, and all forms of material success. The refinements and intellectuality of Europe were supposed to be wanting in our lives. We were a nation devoid of ideals, uncultured, uncouth, and altogether beneath the more refined civilization of the older nations. But is this found to be true? Have we not, on the contrary, discovered that some of our biggest business men are steeped in the learning and wisdom of by-gone days? Is not every action found to be guided by deep-set principles? Acts, heretofore inscrutable, have become understandable. What previously has appeared capricious is suddenly shown to be governed by reason and logic; and as a great scientist will, from a multitude of apparently unrelated and chaotic facts, formulate a theory that will disclose an almost divine order and system, in the place of a supposed disorder and confusion, so do we see here, through an understanding of the great Scotch philosophers, that the apparently capricious and arbitrary deductions of the smelters are only what a philosophical mind should reasonably expect.

CHAS. A. PORTER.

Kingman, Arizona, December 15.

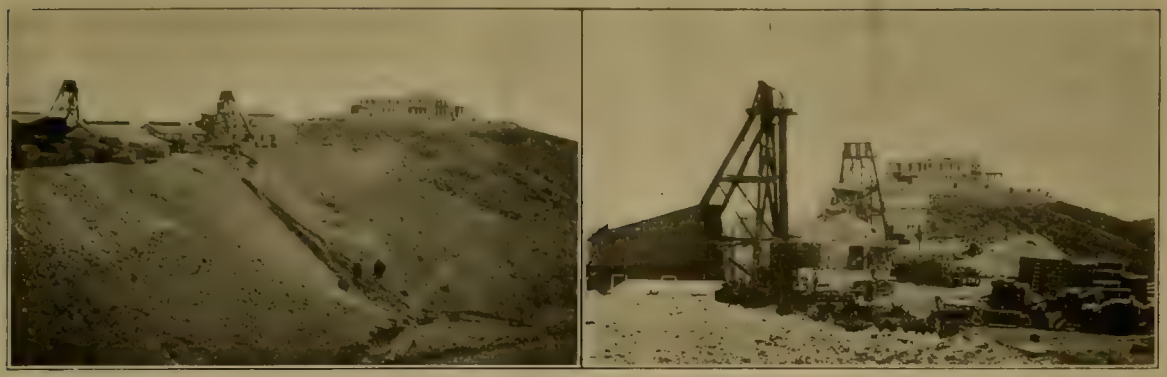
Geology of the Success Mine

The Editor:

Sir—There has been considerable controversy as to priority of the ore and monzonite (locally known as granite and will be so designated hereafter) in the Success mine, in the Coeur d'Alene. F. L. Ransome of the U. S. Geological Survey, in Professional Paper 62, took the view that the granite was there first. Oscar H. Hershey, after an extensive examination, concluded that the granite was post-mineral, and so expressed himself in a paper in the MINING AND SCIENTIFIC PRESS about two years ago. Joseph B. Umpleby followed this with an examination about a year ago and confirmed Mr. Ransome. Mr. Umpleby based his conclusions upon the replacement of the granite by ore, which he determined by sections under the microscope. Not being a geologist I am unfamiliar with the proper weight to be attached to microscopic work, but, from a physical point of view, there always appeared to me to be a doubt, since, in all specimens of granite containing stringers of ore, these are invariably a continuation of quartzite stringers partly replaced, and the question always comes to my mind whether these stringers might not be a replacement of quartzite stringers in the granite, the quartzite having been entirely replaced. I have, however, recently obtained a specimen of a nodule of granite entirely surrounded by ore. A chunk of apparently solid ore was broken open and found to contain a nodule of granite nearly as large as a hen's egg. It was taken from a spot where numerous stringers of granite extended into the ore. The neck of granite which connected this nodule to the parent body must have been wholly replaced by ore. This seems to me to give conclusive proof that the granite was there first. If I am mistaken I am willing to be corrected.

S. R. MOORE.

Sunset, Idaho, December 10.



THE EDITH AND THE CONCRETE SHAFTS, AND MR. DOUGLAS'S HOUSE

The Story of the U. V. X. Bonanza—I

By T. A. RICKARD

The most remarkable discovery of ore made in recent years is that which has given more than local fame to the United Verde Extension mine, at Jerome, Arizona. Jerome[1] is in Yavapai county and 25 miles north-east of Prescott, formerly the capital of Arizona and always an important mining centre. See map, Fig. 1. For about forty years Jerome has been identified with the United Verde mine, although the first claim[2] in the district was located as early as 1876. The ground now included in the United Verde is said to have been worked for silver ore between 1880 and 1885. No silver-reduction plant, however, was erected. The ore was smelted for copper as early as 1883, when a 42-inch water-jacket furnace wes erected. The president of the company that operated the United Verde at that time was F. A. Tritle, formerly governor of Arizona, and still earlier the manager of the Yellow Jacket mine on the Comstock lode. The secretary and treasurer of the company was Eugene Jerome, of New York, and it was after him that the town of Jerome was named. This company produced a considerable quantity of copper, in the form of black copper and matte, until 1887, at which time the resources of the mine appeared to be depleted. In 1888 William A. Clark, subsequently Senator from Montana, bought the property and started fresh exploratory work.

In 1884 Mr. Clark was appointed commissioner to represent the State of Montana at the New Orleans exposition. Among the mineral exhibits he noticed some samples of copper ore from the United Verde mine; these interested him because the assays attached to the specimens showed that gold and silver were associated with the copper. In his usual methodical manner he recorded a note on the subject. Returning to Montana, he forgot about it. His mines at Butte, which were highly productive, supplied ore to the Port Orford Copper Co. in New Jersey. When this refinery went into liquidation, in 1886, Mr. Clark was one of the chief creditors. He assumed the control of the refinery and operated it for a year or more. When examining the records he found assays of shipments of ore from the mine in Arizona that had supplied the specimens he had noticed at New Orleans. Thereupon he sent Joseph L. Giroux to examine the United Verde. Mr. Giroux found that the controlling interest in the property was under option to some people represented by James Douglas, so he arranged to have the refusal. Dr. Douglas decided not to exercise his option, because, so I am informed, the lode was spotty; whereupon Mr. Giroux informed Mr. Clark, who came at once, and, after an inspection, purchased 70% of the stock, acquiring most of the remainder in after years. The Senator for Montana had no liking for geologists, he did not retain a geologist on his staff, and he excluded visiting geologists. Therefore he failed to inform himself concerning the geologic structure of the Jerome district, and it remained for the son of Dr.

[1]On a map accompanying a paper by the late John F. Blandy on 'The Mining Region Around Prescott, Arizona,' in Vol. XI, Trans. A. I. M. E., the position of Jerome is indicated by the name 'Wade Hampton' and the description 'Copper mines.' This paper was read in February 1883.

[2]The Verde, so named on account of the green stains of copper, is usually mentioned as the first claim located in the district, but, on inquiry, I find that the Verde was located on May 16, 1886, whereas the Azure (another reference to oxidized copper mineral) Northwestern, Azure Southeastern, Chrome Northwestern, Chrome Southeastern, Eureka, and Wade Hampton claims constituted the earliest group of locations. Of these the first to be recorded was the Chrome Southeastern, on February 19, 1876, by John O. Dougherty and John P. Kelly.

Douglas, as we shall see, to find and develop a mine as rich as the United Verde in the immediately adjacent ground.

In 1892 the United Verde paid its first dividend and shortly thereafter this mine took rank as one of the great copper enterprises of the world. The United Verde has produced 800,000,000 pounds of copper and is credited with a reserve of ore likely to yield as much more.

During the greater part of its history the Jerome district was a 'one-mine' camp. It could boast only one noteworthy enterprise. No extension of the United Verde orebodies was found, mainly because a master-fault with a big throw spoiled the chance not only of tracing the ore-zone but of exploring the adjacent claims, except at a prohibitive cost. Senator Clark did not permit visitors to inspect his mine, his policy being to exclude operators from the vicinity.

In 1900 a surveyor named J. J. Fisher located a fractional claim out of which grew the enterprise now known as the United Verde Extension. Fisher was not in the employ of Clark; he was a U. S. Deputy Mineral Surveyor and in that capacity had been employed occasionally by Clark and by others in the district. At the time when he discovered this fraction of vacant ground he was surveying for the late George W. Hull, a successful miner, merchant, and State legislator, who had lived at Jerome for many years and was keenly alive to the importance of tracing the United Verde ore-zone into outside ground. Fisher found a fraction covering less than an acre, between the March claim, belonging to Hull,

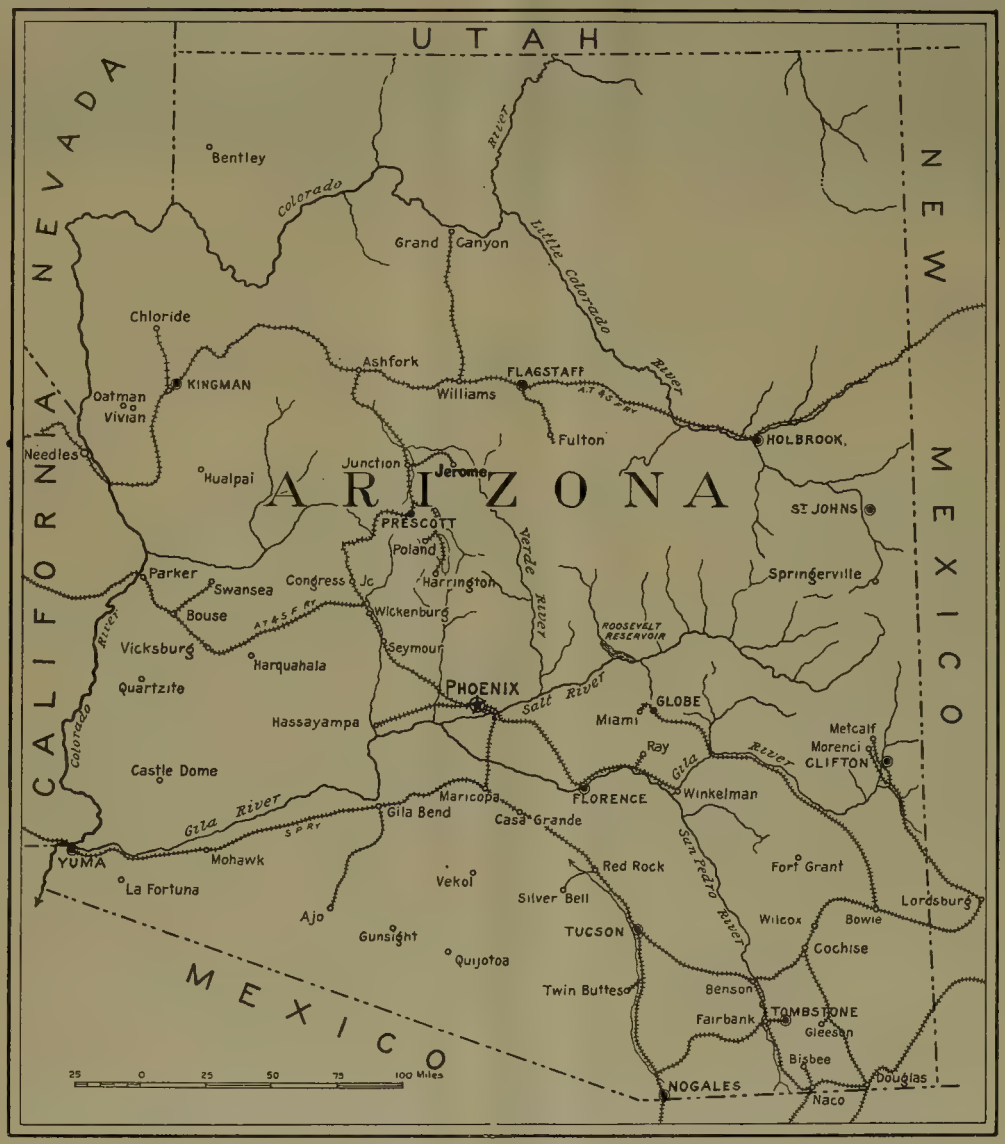


FIG. 1. MAP OF ARIZONA, SHOWING POSITION OF JEROME

and the United Verde property. He located it under the name of the Little Daisy and persuaded L. E. Whicher to take an option on the property, the latter selling enough stock to start the sinking of a shaft, under the superintendency of E. A. Powers. That was in 1900. This shaft was sunk 300 ft. through the lava and limestone covering the ore-bearing formation, which is schist. At about 100 ft. the shaft penetrated ground that showed signs of ore, but nothing of value was discovered in the drifts and in 1901 operations ceased. The enterprise seemed to be blighted by the fact that the most promising workings were within a hundred feet of the March claim, owned by Hull, as already stated. Fisher found it difficult to obtain any additional financial aid and the Little Daisy remained idle until Mr. Whicher acquired the claim for 5000 shares of a company that he organized in 1906, and shortly thereafter the shaft was deepened to 800 ft., again under Fisher's direction. He unfortunately did not live to see his hopes fulfilled, for he died in 1911.

In order, however, to explain the true relation of Fisher's enterprise to that of Hull, it is necessary to record the vicissitudes of early exploration and promotion. In 1899 the first company to prospect this area was organized by Hull; it was called the United Verde Extension Gold, Silver & Copper Mining Co.; it became known as the U. V. X. and its successors have had the various modifications of the name abbreviated likewise. Throughout Arizona the mine is known by its initials. This first company controlled a dozen claims, including the territory directly west of the United Verde, with the ground north and south, so as to enclose Senator Clark's property on three sides. This company was capitalized for 300,000 shares of $10 each, and was organized under the laws of Arizona. In March 1899 Louis E. Whicher, of Schofield, Whicher & Co., at Boston, became interested in the promotion of the company at the instance of the late Franklin Farrell and associates. At the last moment Farrell had some disagreement with his associates and withdrew, but Whicher proceeded with the business, the

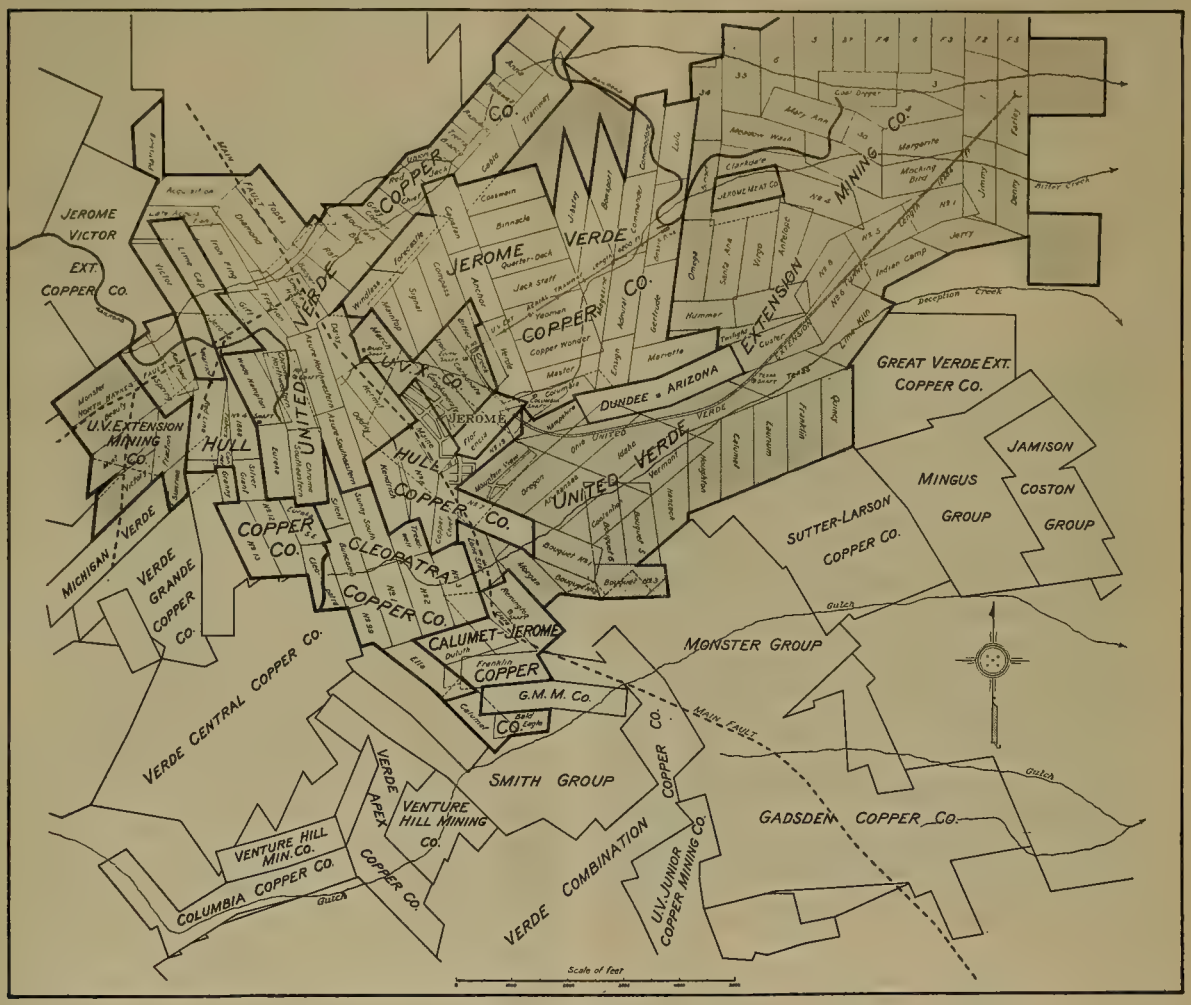


FIG. 2. PLAN OF MINING CLAIMS IN THE CENTRAL PART OF THE JEROME DISTRICT. THE UNITED VERDE EXTENSION PROPERTY IS SHADED

result being that he and his clients acquired 190,000 shares, Hull retaining 110,000 shares. Mr. Whicher became the largest individual shareholder, his holdings representing $100,000, which also was the amount of cash available for exploratory work. A shaft was sunk on the claim called '1888' (See map, Fig. 2), this shaft being within a stone's throw of the United Verde shaft. Mr. Whicher obtained the professional advice of a competent engineer, Milton F. Johnson, and was encouraged in the belief that if there were any ore to be found outside the United Verde, it would be east of that property. At this time, in 1900, Fisher had located the Little Daisy fraction, and was trying to get money for prospecting. Whicher obtained an option on the Little Daisy for $50,000 and sank a shaft upon it to 300 ft., of which 125 ft. passed through oxidized coppery rock, too low-grade to be ore, but so promising that Mr. Whicher was prompted thereby to begin negotiations with Hull for the acquisition of the claims adjoining the Little Daisy, namely the March, Conglomerate, Iron Carbonate, and Bitter Creek locations. This transaction followed upon a curious episode. In 1900 Hull had begun divorce proceedings at Providence, and was arrested on the train, while passing through this town, for having sworn incorrectly that he was a resident of the State of Rhode Island. At this juncture he appealed to Whicher to help him out of his predicament; Whicher took Hull to Boyd B. Jones, of Boston, then District Attorney of Massachusetts, and by his aid Hull was extricated from his entanglement. The immediate sequel was that Hull, now in a docile state of mind, made a trade with Whicher, whereby Hull transferred his 110,000 shares to the U. V. X. company and also deeded the four claims above-mentioned, in exchange for the properties originally owned by the U. V. X. company. These four claims had been incorporated under the name of the King Development Co. In return, the U. V. X. company transferred to Hull all the various claims that it owned around the United Verde property. By this exchange the U. V. X. company became the owner of Hull's four claims and, shortly thereafter, of the Little Daisy fraction, which Whicher acquired for the company from Fisher for 5000 shares of U. V. X. stock.

These deals having been consummated, the U. V. X. company was re-organized, in 1902, under the laws of Maine, but with the same capitalization, namely, 300,000 shares of $10 each. In 1910 another re-organization was effected, this time under the laws of Delaware, the capital being increased to 400,000 shares of the same par value.

Meanwhile Mr. Whicher persisted in his prospecting. The Little Daisy shaft was sunk to 800 ft., and a search for ore was made under Fisher's direction. From 1907 to 1911 C. C. Burger was consulting engineer to the company and showed sustained confidence in the outcome of the exploratory work. In March 1911, Mr. Whicher arranged for an examination by R. M. Atwater, Jr., who reported favorably. In his report, which is before me as I write, Mr. Atwater stated that his experience led him "to expect high-grade copper orebodies at or near the water-level." He concluded by stating: "I believe the chances of finding valuable orebodies are excellent." This is dated April 8, 1911. At the same time Mr. Burger reported the finding of ore assaying 2.6 to 3.1% copper, with $2 in precious metals, in a winze then 65 ft. below the 800-ft. level. The copper was in sulphide form, but it showed signs of leaching. This 'near-ore' looked promising, but a more important find was a patch of 39 to 42% ore cut in an eastern cross-cut from the 700-ft. level. This chalcocite ore was 5 ft. wide and 15 ft. long, averaging 18.7% copper, as stated by Mr. Burger. Along the 800-ft. level a much larger body of low-grade oxidized material had been exposed and its downward persistence was indicated by the winze. Yet the enterprise languished. The finding of the chalcocite patch caused the shares to jump to $4. It was a mere flash in the pan. Several other experts came to Jerome to make an examination, they reported adversely, and in kindness to them I abstain from giving their names. They accounted for the copper in the schist, particularly in the main east cross-cut from the 800-ft. station, by supposing it to be due to solutions originating in the United Verde orebody. The patch of chalcocite failed to impress them. In the summer of 1911 Whicher interested Theodore Gross and A. Chester Beatty in the venture and on Mr. Beatty's initiative a mining geologist of acknowledged ability inspected the U. V. X., but he reported that the conditions were unfavorable.

Up to this time about $500,000 had been spent in the search for a real orebody. Fisher had been serving as manager for the U. V. X. company until January 1911, when he was succeeded by Thomas A. Varden, of Butte. Mr. Whicher was president of the company.

In 1908 Major A. J. Pickrell had purchased stock from Fisher and for a time he had served as a director of the company. Through him the U. V. X. was destined to obtain the financial assistance needed to bring the enterprise to fruition. In December 1911, shortly before Fisher died, Major Pickrell wrote to James S. Douglas, urging him to come to Jerome and look into the business. Mr. Douglas is the son of James Douglas, the dean of copper mining in Arizona, long identified with Phelps, Dodge & Co., and with all that is honorable and scientific in the mining industry of the South-West. In April 1893, while James S. Douglas was in charge of the Senator mine, ten miles south of Prescott, he came to Jerome to repair a compressor-shaft, simply because Senator Clark's machine-shop at the United Verde mine was the nearest available. Subsequently he visited Jerome a number of times to see George Hull, and in this way he acquired some familiarity with local conditions. In June 1899 he met Colonel D. P. Bosworth, of Marietta, Ohio, the enthusiastic promoter of the Verde Queen mine, which is on the limestone cap just east of the town of Jerome. The Colonel had uncovered a little carbonate ore in the bed of Bitter creek on the Columbia and Verde claims, the latter an early location covering the ground on which Mr. Douglas's house now stands. Bitter creek crosses

the line of the big fault and collects the drainage of the hillside below the United Verde mine. This property of Colonel Bosworth was re-organized later, becoming the Jerome Verde, now prominent among the prospecting ventures in the district. Bosworth consulted Douglas, who, in this way, obtained some further knowledge concerning the local geology. Upon his arrival at Jerome in December 1911, on the invitation of Pickrell, as already stated, Douglas was shown the workings on the 800-ft. level of the U. V. X., but he was unable to examine the winze or the lower workings, then down to



U. V. X. MINE IN RIGHT FOREGROUND; UNITED VERDE SLAG-DUMP IN BACKGROUND; BITTER CREEK BETWEEN; LITTLE DAISY SHAFT IN GULCH BELOW SLAG-DUMP

1200 ft., on account of water. However, what he saw impressed him so favorably that negotiations were commenced, leading to an option. This option was submitted to Phelps, Dodge & Co., whose counsel (William Church Osborn) at New York, disapproved of the transaction on account of some fancied defect in the title, in which supposition he proved to be wrong. The organization of the U. V. X. company and the examination of titles had been placed by Mr. Whicher in the hands of Brandeis, Dunbar & Nutter, the senior member of this firm being Louis D. Brandeis, now a Justice of the U. S. Supreme Court. Dr. James Douglas and his associates were favorably disposed to the deal, but the technical objection of their legal adviser caused them to drop the business, whereupon Major Pickrell again urged the younger Douglas to interest himself in the enterprise—this time successfully.

In the summer of 1912 Mr. Douglas and George E. Tener, of Pittsburgh, took the venture in hand and invited their friends to join them in providing $225,000 for the development of the property. These two gentlemen decided that it was futile to attempt further search for ore from the bottom of the Fisher winze, but that the prospect justified the sinking of a new shaft at a spot 2000 ft. east of the Little Daisy shaft. Under date of August 14, 1912, they sent the following letter to a number of mining engineers, metallurgists, and mine operators:

"George E. Tener and J. S. Douglas have secured an option on 450,000 shares of stock of the United Verde Extension Mining Company.

"The United Verde Extension Mining Co. is capitalized at $750,000,[3] with 1,500,000 shares of a par value of 50 cents each.

"The original stockholders own, in round numbers,

[3]This represented an increase to 1,500,000 shares of 50 cents each, as compared with the former capitalization of 500,000 shares of $10 each, as covered by the contract between Douglas and Whicher, the president of the company.

400,000 shares, and George E. Tener and J. S. Douglas have an option on 400,000 shares and have paid $25,000 into the treasury of the company for 50,000 shares.

"500,000 shares will be left in the treasury.

"The option on the 400,000 shares runs to June 15, 1915, and the shares are to be purchased as the Treasurer may require funds for development work, at the discretion of the Board of Directors who will be controlled by Mr. Tener and Mr. Douglas.

"As a commission for services the United Verde Extension Mining Company are to pay Mr. Tener and Mr. Douglas 150,000 shares proportionately as the money is placed in the treasury. A proportion of the stock received by Mr. Tener and Mr. Douglas as commission from the United Verde Extension Mining Company is being used by them for organization purposes, but to comply with the law of the State of Delaware it must be issued to them for services rendered.

"They propose to extend to you the privilege of subscribing for .... shares at $0.50 per share, equals $...., this subscription being subject to the call of the Treasurer, Mr. C. P. Sands, at 280 Broadway, New York, who will most likely call for 20% of this amount on close of this subscription list, and the balance as needed, which will probably be at the rate of 20% every three or four months. The Treasurer will forward stock to you as amounts are received in response to each call.

"It is proposed to expend $25,000 in development work on the present 800-ft. level of the United Verde Extension Mining Company's property at Jerome, and if the results are satisfactory to expend $200,000 at the rate of about $10,000 a month, cross-cutting and drifting at that level.

"Mr. Tener and Mr. Douglas are not asking their friends for subscriptions, but believe that their plan for the development of the United Verde Extension Mining Company's property will result in the discovery of valuable orebodies, and in sending you this letter, it has occurred to them that you might consider it a favor to be permitted to join in a speculation which they recommend as such."

I have given this letter verbatim, so that the reader can decide for himself whether it would have caused him to take a share in the gamble, for it was that frankly. The last paragraph makes it clear that the two promoters of the enterprise were not begging for financial assistance. The letter is unlike the ordinary prospectus in that it states the principal conditions plainly and truthfully, without any iridescent touches. It seems to me that my own response—supposing that I were not an editor under a self-imposed obligation not to speculate in mines, in order to conserve my position as an unbiased commentator—would have been guided entirely by my confidence in the integrity of the two promoters and my opinion of their sagacity in such a business. Mr. Tener was known to most of the invited subscribers as an experienced and honorable mine-operator; he was the organizer and one of the directors of the Calumet & Arizona venture, and he had been connected for many years with the Oliver Mining Co., a big iron enterprise in Minnesota. He lives at Pittsburgh and is the brother of a former Governor of Pennsylvania, John K. Tener. But it is no reflection on him to say that it was mainly on the recognition of Mr. Douglas's good sense and practical experience, plus unquestioned confidence in his good faith, that the money was subscribed promptly.

More than a third of the stock of the company, then reorganized as the United Verde Extension Copper Co., is held in Arizona. James Hoatson, of the Calumet & Arizona Copper Co., visited the prospect and approved the venture cordially. He owns 16,000 shares. George Kingdon, a Cornish mine-captain,[4] then in charge at Cananea, endorsed it heartily before the new work was commenced. Today he owns 18,000 shares. Among the other subscribers were Charles Briggs, W. H. Brophy, H. Kenyon Burch, Chester A. Congdon, James Douglas, Walter Douglas, John C. Greenway, Thomas Hoatson, Arthur C. James, L. D, Ricketts, John D. Ryan, Casper Schultz, W. D. Thornton, and J. S. Williams, Jr. It will be noted that Mr. Douglas's father and brother both supported him by taking stock. The money was raised by means of five successive calls for $40,000 each at 50 cents per share, so that with the $25,000 that Messrs. Douglas and Tener themselves furnished, before they asked their friends to come in, there was $225,000 available for exploratory work.

In April of the same year an examination of the mine was made by Ira B. Joralemon, mining geologist to the Calumet & Arizona Mining Co. In his report Mr. Joralemon said that he would expect to find good sulphide ore at a moderate depth below the leached and mineralized material on the 800-ft. level. He suggested that "the leached and crushed area in the Little Daisy might be part of a shear-zone, like that in which the great orebodies of Jerome occur. While the result of the work is a gamble, there is chance of finding a mine worthy of being compared with the United Verde." He concluded by stating: "I think the chance is worth taking."

This advice justified a group of men in spending money that they could afford to lose. It confirmed the previous opinions of Messrs. Burger and Atwater. Mr. Joralemon received some shares in part-payment for his report, but took his profit prematurely when they rose to $6.50. Here I may anticipate by saying that the shares rose to $45 when the wonderful orebody was uncovered on the 1400-ft. level. Before that consummation was reached, however, several shareholders showed reasonable conservatism, or 'cold feet,' as you will, and sold out almost as soon as they could get back the money they had put in. However, most of the original subscribers held on, becoming rich men, if they were not rich already. Captain Hoatson persuaded a number of his friends in Michigan to buy stock and I doubt not that

[4]Formerly superintendent of the Old Dominion mine, at Globe, and a fellow-worker with Mr. Douglas for many years in Arizona and Sonora. He is now resident manager for the U. V. X. company.

he increased his personal popularity thereby. Most of those that were too 'sane' to go into the 'gamble' are very sorry indeed, and I fear that some of them may smile engagingly at the next 'wild-cat' that grins at them amid the Arizonan cactus. But I am far ahead of my story, the most important part of which remains to be told.

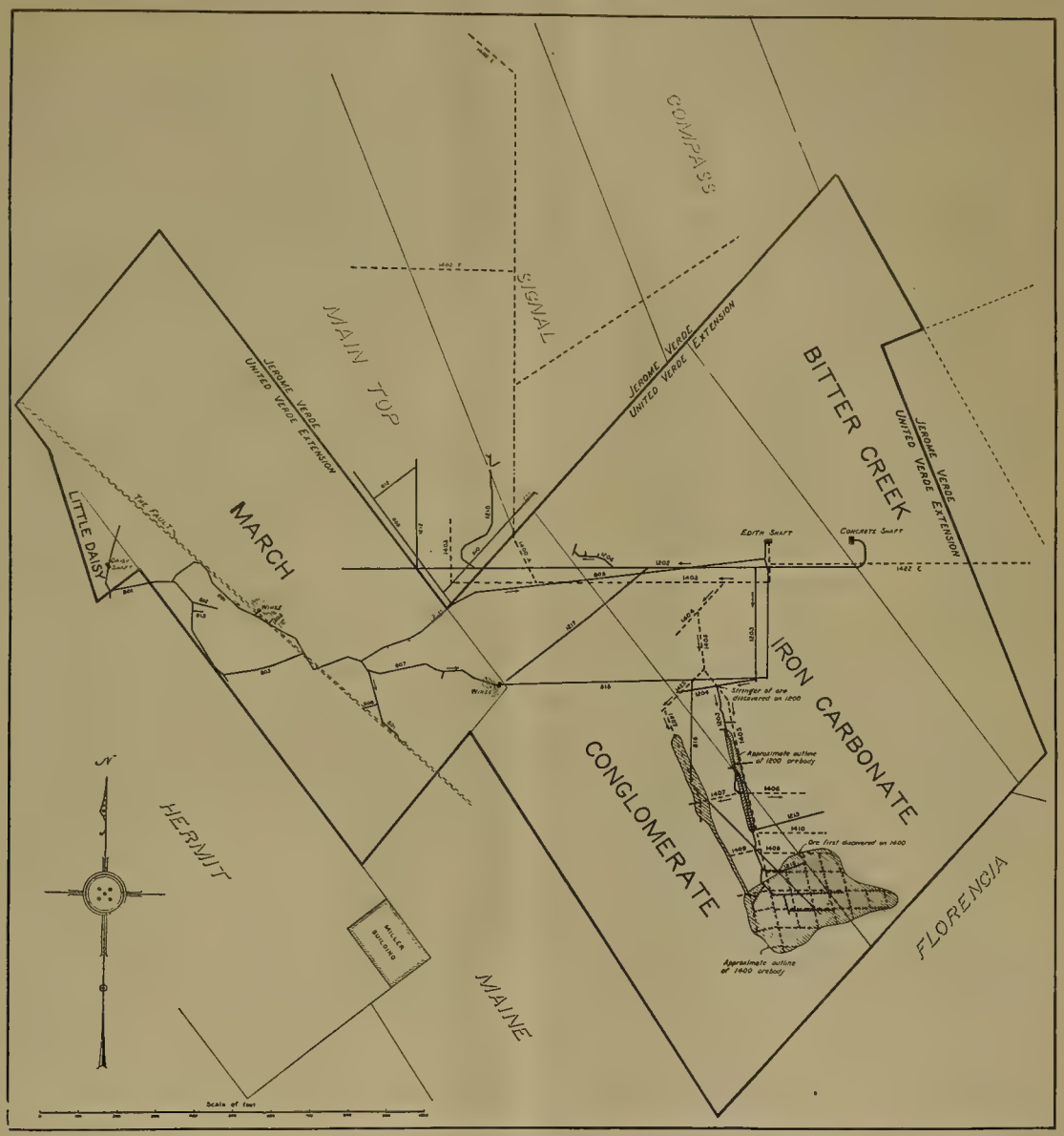


FIG. 3. PLAN OF THE U. V. X. WORKINGS. NUMBERS INDICATE THE ORDER IN WHICH THE WORK WAS DONE

In June 1913 a new shaft, called the Edith, after Miss Edith Tener, was started at a point 1900 ft. east of the first, or Little Daisy, shaft. This new shaft penetrated 180 ft. of lava, 400 ft. of limestone, 90 ft. of sandstone, and then reached the schist at 570 ft., which was equivalent to the 800-ft. level of the old shaft. A cross-cut was extended to the Main Top claims of the Jerome Verde company, under an option whereby the two properties were to be consolidated if ore was found. Under this agreement 2760 ft. of exploratory work was done on the 800, 1200, and 1400-ft. levels, without productive result. The search for ore in the U. V. X. ground likewise proved disappointing. It was decided to sink 200 ft. deeper, to the 1400-ft. level, and to cross-cut into the Main Top ground at this level, also by request of the Jerome Verde company. No ore was found. By September the $225,000 of working capital had been spent and it became necessary to call upon the U. V. X. shareholders to subscribe for their proportion of additional stock at $1 per share. This they did unhesitatingly. The issue, however, was previously underwritten by

Messrs. Douglas and Tener. Thus $50,000 was raised by the sale of treasury stock. The company was capitalized at 1,500,000 shares of 50 cents, making $7,500,000, of which now $525,000, or 1,050,000 shares, had been issued. The old company had 500,000 shares of $10 each, and of these 380,000 had been issued. When the re-organization was made by Messrs. Douglas and Tener they exchanged shares with the former stockholders, thus accounting for 380,000 shares. They received 170,000 shares as the profit of the promotion and of this amount they paid some of those that had helped them in the deal. They bought 50,000 shares at par, paying $25,000; they placed 400,000 shares at par among their friends, thereby raising $225,000 for working capital; and finally they issued 50,000 treasury shares at $1 for further working capital. Thus 1,050,000 shares had been issued. No ore having been found in the Main Top ground of the Jerome Verde, that option was dropped in June 1915. Meanwhile all the available funds having been exhausted, including the last $50,000 obtained from the sale of the 50,000 treasury shares, Messrs. Douglas and Tener, not wishing to ask their friends to take more treasury stock, advanced $25,000 personally in the fall of 1914, and concurrently they engaged the services of one of the foremost geologists in the country to examine the mine and to show them where they had erred in looking for ore and to give them such advice as might haply lead them to find something before abandoning the entire project, which at that time seemed doomed. After a thorough examination, the distinguished geologist, whose name is purposely withheld, condemned the mine and strongly advised his clients to cease operations. This opinion was so strong and stated in such positive terms that the management felt relieved of a great responsibility and appeared justified in stopping work. As one of the principals says: "The position looked so bad that all further work seemed useless; it appeared time to gather up what salvage there might be, and close down the mine, swallow the loss, and forget it." However, as the Cornishman says, "Never abandon a drift until you have driven 20 ft. farther." The management persevered a little longer, and in December a cross-cut being driven toward the centre of the U. V. X. ground from the main 1200-ft. level, connecting the Daisy and Edith shafts, cut five feet of 45% copper ore. This proved to be part of an orebody 120 ft. long and reaching a few feet above the 1100-ft. level. From this orebody about $600,000 worth of ore was mined during 1915. The prospect had become a mine, but its resources had only been touched. A drift was started on the 1400-ft. level to intersect the continuation of the ore discovered on the 1200-ft. level, but it went beyond the point where ore was expected without finding anything. No cross-cutting was done until January 1916 because a heavy flow of water had been cut south of the ore on the old 1200-ft. level, which at this time was not drained. It became necessary to install pumps at the 1400-ft. station and to provide bailers. The exploratory drift extending under the upper orebody had been stopped in a kaolinized rock, which encouraged expectations. This point was 850 ft. south of the Edith shaft. See map, Fig. 3. As soon as the pumps were in place, a cross-cut was driven both east and west in the hope of cutting the north end of the high-grade ore uncovered on the 1200-ft. level. Both of these cross-cuts drew a blank, for, as was shown later, the orebody had taken an abrupt dip westward at a point 60 ft. below the 1200, so that the cross-cuts were too far east. The next cross-cut eastward was started 100 ft. south and found nothing, but the third (now labeled 1408) cut 16% ore when it had been advanced 40 ft. from the drift, and it continued in ore for over 200 ft. The main drift was extended into the orebody and cross-cuts were driven at intervals of 50 ft., proving a new orebody that reached to within 180 ft. of the Florencia side-line, which is the south-eastern boundary of the U. V. X. property[5]; indeed, the south-eastern end of the orebody reaches to within 30 ft. of that boundary. This, of course, was not the orebody cut on the 1200-ft. level, but a new and much bigger orebody, as the map shows. The smaller orebody discovered on the 1200-ft. level corresponds to the one known on the 1400-ft. level as the 1407, which was opened up subsequently by extending the first cross-cut run in a westerly direction.

On the 1400-ft. level the main orebody has an extreme width of 260 ft. and a length of 440 ft. It covers 62,400 sq. ft. One ton of ore occupies 7 to 7½ cu. ft. The upward termination of the main orebody is at 1240 ft. The ore is chalcocite, of secondary origin, of course. When I first saw a carload of it, just off the cage at surface, it looked like bituminous coal; it blackens the fingers. That carload assayed about 40% copper or as much as the concentrate made laboriously in the Miami and Inspiration mills. Indeed, it is a concentrate made by nature. In April 1917 the mine produced 4390 tons of 38% ore and 7029 tons of 26% ore, containing therefore 6,991,480 pounds of copper, worth $2,167,358. The primary ore succeeds the secondary somewhere between 1500 and 1600 ft. Between 1250 and 1500 ft. there is estimated to be 2,000,000 tons of 15% ore, representing 600,000,000 pounds of copper, to be produced at a cost of 7c. per pound, leaving a profit of 10c. per pound, even if the price of copper averages no higher than 17c. during the period of exploitation. Thus a profit of $60,000,000 is indicated. Experience in the United Verde shows that the primary ore averages 5% copper, and vertical development in that mine reaches to a depth of 1500 ft. in the schist. The U. V. X. may obtain 5000 tons of such ore per vertical foot, so that 1,500,000 tons of 5% ore, equivalent to 150,000,000 lb., is calculable. This ore, if exploited at a cost of 8c. per pound, would give another $13,500,000 in profit. The management assumes no responsibility for any of these estimates. I give them on my own responsibility, as an essential part of the story. There should be enough rich ore to last for eight years and during this period there will be ample opportunity to ascertain the further riches of the mine. It is not

[5]The U. V. X. company owns two-thirds and Mr. Clark one-third of the Florencia claim.

likely that the output of the mine will consist only of the richer ore until all of it has been exhausted; on the contrary, reasons, economic and technical, will prompt an admixture before smelting. Therefore 3,500,000 tons of 10% ore may be taken as more nearly representing the assured resources.

Rich as it is and splendidly productive, the U. V. X. is a little mine; as measured in tonnage it makes a small output compared with the big low-grade disseminated-copper mines in other parts of Arizona. The Inspiration produces 20,000 tons per day of $9 ore; the U. V. X. produces only 300 tons of $150 ore, or $45,000 per day. This is a wonderful output to be made by a small base-metal mine. During 1916 the U. V. X. produced 36,402,972 lb. of copper from 77,461 tons of ore, an average of 23.5%[6] copper, besides 2570 oz. of gold and 128,468 oz. of silver, the total output being worth $9,949,918, of which $7,400,000 was profit. It had proved a glorious bonanza!

(To be continued)

Concrete Fords for Crossing Streams

The construction of concrete-paved fords in place of bridges across shallow intermittent streams with sandy bottoms is discussed in an article in a recent number of 'Portland Cement.' Where the bed of the stream is considerably lower than the banks, or where the normal flow of the stream is considerable, such fords are not recommended.

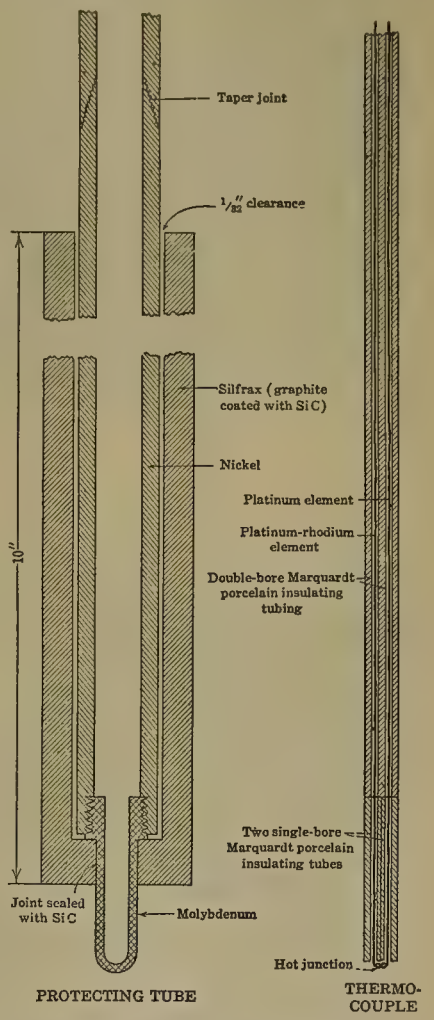
In constructing a ford, 2 by 6-in. timbers should be used for side-forms and drag-guides. The top of the form should be placed at the average elevation of the sandy bed of the stream. The sand between the forms is then removed to a depth of 6 in. A trench is excavated just inside the forms so as to provide a mold for a concrete baffle-wall. The trench is made deeper on the down-stream than on the up-stream side, since the former is more subject to wash. The baffle-walls are also carried across the ends of the ford. The ford should be made level at the bottom, and inclined, where necessary, at each end. The concrete is then placed. Triangular mesh or else ⅜-in. twisted bars may be used for reinforcement. When required, some sort of apron-construction can be used. If the stream is not entirely dry under ordinary conditions, a concrete box-culvert can be combined with the ford. A plain concrete ford 16 ft. wide can be built for $2.50 to $3 per lineal foot.

A TANK-STEAMER with no reciprocating machinery in the engine-room is being built in a shipyard on the Delaware. The propelling engine will consist of a low and a high-pressure turbine geared to a single propeller, a surface-condenser with a centrifugal pump driven by a turbine, two centrifugal hot-well pumps also driven by a turbine, and a rotary oil-pump for the turbine and gears, driven from the main gears.

[6]The output for 1917 will have averaged about 4,000,000 lb. per month.

Bureau of Mines Pyrometer

To measure satisfactorily the temperature of molten metal a pyrometer that will combine accuracy, long life, and speed of reading is essential. No pyrometer on the market is fully satisfactory for this purpose, but in the Bureau's work one was devised that has given good service for laboratory use. The illustration shows the details of the instrument. The protecting tube consists of a nickel tube tipped with molybdenum and encased in another tube made of silfrax (graphite coated with SiC), as shown. The thermo-couple consists of a platinum element and a platinum-rhodium element carried in Marquardt porcelain insulating-tubing. The graphite and molybdenum come in contact with the molten metal, but neither is attacked by it. The nickel tube resists oxidation. The small molybdenum tip heats up quickly, the lag of the device averaging 50 seconds in metal at 1200° C., with the tip cold at the start. Other nickel tubes are threaded into the lower one to give a tube three or four feet long, and the outer end is fitted with any suitable handle.



Mining at Butte

By BEN F. EVANS

For a short time prior to June 1917 the labor element in the Butte district passed through a period of unrest. This was caused by many unusual factors, namely, the general prosperity of the working people throughout the country, caused by high wages, the war crisis, numerous strikes, the pro-German propaganda, professional agitation of the I. W. W. type, and undesirable working conditions. All of these factors tended to bring the majority of the miners to a common understanding. The unrest was brought to a climax by the fire in the Granite Mountain shaft, on June 9, when 160 men lost their lives. Two days later the Butte Metal Mine Workers Union was organized. This was inevitable and would have happened in a short time even if there had been no accident, but the opportunity, when all the miners had so much in common to talk and think about, was seized by the labor-leaders. Demands were then drawn up and presented to the operators. They included an increase of wages, changes in working conditions, abolition of the rustling card, committees composed of company representatives and union men not only to settle disputes but also to examine and make reports on underground conditions. These demands were not accepted. A strike followed. It can be added that many of the demands in a modified form were agreeable to the operators, but as modified they did not suit the union.

During the period between June 11 and September 24 the production of copper in the district was practically nil. Most of the miners had only enough men to keep up repairs and operate pumps. Miners left Butte by hundreds, as there was plenty of work in neighboring mining and construction camps, while many men went to the harvest and hayfields. Those with families, forced by circumstances to remain, received financial aid from the miner's organization, it is understood. Several local societies and business concerns contributed financially to the aid of the union. It is known that the organization also received help from organized labor outside the Butte district. During the early part of this period the crafts also were in an unstable condition. Some were, and others were not, in favor of affiliating the new union with this organization, and a strike was daily expected, but when it came to a vote the majority of the different crafts decided against affiliation. This decision was disliked by the members of the new union; they maintained it was unfair, and based their claim upon the fact that an organization with a small number of men had the same power as one with a great many; thus the decision was not representative of the men's feelings or sympathies.

It must be understood that the miners' strike in Butte automatically closed the concentrators and smelters in the cities of Anaconda and Great Falls, as these plants depend upon the Butte mines for their ore. The members of the smeltermen's union were then easy victims for the strike germ, which pervaded the atmosphere at that time.

About this time, or, to be exact, on the thirtieth day of July 1917, an agreement was entered into between the Anaconda Copper Mining Co. and the State Metal Trades Council, affiliated with the American Federation of Labor, through its local unions, which apparently satisfied all concerned, and went a long way in straightening out the labor situation. It conceded a rise of 25 cents per day (beginning at $3 to $5 as the standard wages for different occupations) for each two cents rise of copper above 15c. per pound, as set out in a detailed schedule annexed to the contract. All over-time (including Sunday work) to be paid for at the rate of time and a half. A weekly pay-day is established. The company agrees to employ none except members of the affiliated unions. The State Metal Trades Council agrees to expel or discipline any rebellious 'locals' breaking the contract. The company absolves itself from settling any question of jurisdiction between local unions, leaving that to the Trades Council and American Federation of Labor.

From the time the agreement went into effect no trouble of any consequence has arisen from the crafts, although there was a walk-out (but no strike) among some of the electrical workers. This was of short duration. The fact that the Government set the price of copper at 23½ cents per pound at this time would have naturally meant a reduction of wages, due to the sliding scale in use, based on the price of copper. The companies, however, decided that it would be better to maintain the existing rate of wages, which was based on copper at 27c. per pound. This scale is to be in effect until the first of January 1918, at least.

During the strike period, one noticeable condition was observed, namely, the absence of serious violence, such as ordinarily accompanies these strikes. The union men had an understanding that violence or lawlessness was not desired, and would not be tolerated. The one black mark in the entire trouble was the hanging of Frank Little, a well-known I. W. W. leader and organizer. The presence of Federal troops in Butte during the height of the trouble and at the present time no doubt had a great influence upon all law-breaking people. The fact that wages were based on 27c. copper, that a great many men were tired of loafing and out of funds, and that no end was in sight for a final settlement, started the men back to work. The dearth of miners in the district at this time was noticeable.



ELM ORLU MINE, OWNED BY W. A. CLARK



PARK STREET, BUTTE, LOOKING WEST

The smaller operators, particularly the zinc-producers, the Butte & Superior Mining Co. and the Clark interests, were the first to approach anything near normal ore production. The Anaconda Copper Mining Co., not being able to start all of its properties at once, and having to get its smelters into working order, was just a trifle slower in getting into its stride again, but soon took the lead in number of employees. As soon as it was generally known around the country that the Butte mines were again working, the men gradually began to come back. All of this in spite of the fact that placards were circulated in many places advising the workers not to return to Butte, because the strike was still on. That the men wished to return was no more than to be expected, as a great many who went away did so just to avoid trouble, and not because they had any particular grievance against the operators. It is also recognized among the miners that Butte affords the best living conditions of any camp in the country. There are no bunkhouses or mess-houses at the mines. The men find accommodations wherever they choose, and most of them have well-heated rooms, with hot and cold water, in some of the most modern blocks in the city, where they are close to any recreation they may desire.

The Anaconda company has been starting up its largest mines as fast as the return of men warrants, until at this time, January 1, 1918, the company is employing 94% of the normal force, and working most of the mines to capacity. This seems remarkable in view of the fact that so many men have left the city to join the colors. In the month of November the output of copper was 21,666,332 pounds, while the output of zinc was 3,955,707 lb. These figures afford ample evidence that operations are rapidly approaching normal.

The high price of silver has helped generally. Old silver properties that had been lying dormant for the past 25 and 30 years suddenly sprang into activity. Practically all of the present large producers in the district showed interest in local silver properties. The demand for manganese for the steel industry went hand in hand with the silver development, most of the old silver mines having good surface showings of manganese. The Anaconda company is developing the Nettie, Orphan Girl, and Bonanza claims. The Butte & Superior Co. is working a group of claims in the silver district, the most important of which are the Germania, Tzarina, and Humboldt. The Clark interests are working the Moulton, Anselmo, and Travona properties. The Butte-Detroit Copper & Zinc Co. has been mining manganese ore at the Britannia and concentrating it at the re-modeled Ophir mill, situated in the south-western part of the city. The Davis-Daly Co. has been doing extensive development work at the Hibernia and Mount Moriah claims, both old silver-producers. This work means a great deal for Butte's future as it enlarges the mining area about one-third and extends almost four miles south-west of its present productive area. These operations have caused much property to change hands, a good omen in the mining world.

The North-Butte Mining Co. has been under great handicap as far as production was concerned. Much repair work had to be done at the Granite Mountain and Speculator shafts. At present the Granite Mountain shaft is being concreted. This is the first work of that kind yet attempted in the district, and the result will be awaited with keen interest. The walls will be solid concrete and heavily reinforced with steel rods. A great many arguments have been advanced in connection with this work. The contention among some mining men is that this work will be more expensive and will not have any greater fire-resisting qualities than a cheaper construction. The heavy moving ground so common in the Butte district is liable to cause considerable trouble and make repairs run high. Ore is being hoisted from the Speculator shafts and shortly after the first of the year a normal production is expected. The company is carrying on development work in the eastern part of the district, a new territory that has not been extensively developed.

In conclusion, I would summarize recent changes as follows:

On December 18 the Metal Mine Workers Union voted to call the strikes off, and return to work. Wages for miners before the trouble were $4.75 per diem, and at present are $5.25. Payment is based on the sliding scale with a base of $3.50 per day when copper is under 15c. and advancing 25c. for every 2c. increase in the price of copper. The rustling-card has been modified. A weekly pay-day is now in operation and has been received with much gratification by the miners. The Anaconda pays in cash, whereas the other companies pay by check as formerly. The weekly pay-day eliminates the wage-scalper or assignment-shark. Formerly all employes were paid monthly.

A great deal of work has been done for the safety of miners, and on precautionary measures in case of fire. This is shown clearly by extensive work that has been done in concreting the Tramway shaft, by the Anaconda company. This concrete is comparable to cement plaster on metal lath. The metal lath is stretched over the shaft-timbers and walls, then nailed in place. The cement is then applied with a cement-gun. This is said to be fire-resisting, and when proved so, it no doubt will be generally adopted at all mines in the district. The same system is being used in underground stations and on fire doors.

Ninety-four per cent of the normal working force is at work, a great deal of development work is going on in a long-forgotten portion of this mining district, and a general feeling of prosperity prevails, as is clearly shown by the increase of business, the successful flotation of the Liberty Loans, Y. M. C. A., and Red Cross campaigns. When these were carefully examined it was found that the numerous small contributions from the mining men, not including the operators, when taken collectively, went a great way in making up the grand total, amounting to a local over-subscription of each allotment.

Mining Laws for Russia

By HORACE V. WINCHELL

[Mr. Winchell was asked by the Ministry of Commerce and Industry at Petrograd to submit suggestions for framing mining laws, in Russia, based upon his experience in the United States. He complied with the request and we are enabled to publish herewith a part of his recommendations, believing them to be interesting to mining engineers in Russia and America.]

We are accustomed to dividing mining laws and regulations into two parts: first, mining laws proper that concern the relations between the prospector and mine-operator and the Government or private landlord, which define the status of the prospector, establish method of procedure, protect him in his possession while searching for mines, and give him assurance of title when all the required conditions have been fulfilled and valuable minerals discovered; second, mining regulations concerning the operation of mines and the safety and health of the employees. It is my purpose to discuss here only mining laws as defined under the first class.

Experience has shown that the prosperity of the mining industry and consequently in large measure, the prosperity of a country, depends largely upon the character of its mining laws. If they are favorable there will be great activity in the operation of mines and great collateral development, such as the building of industrial communities, the construction of railroads and large manufacturing establishments. If the laws are not such as meet with the general approval of the prospector and the capitalist the mining industry languishes and the industries of the country, which is thus compelled to rely upon imports from other lands, also fail to reach their highest development. As an illustration of this fact permit me to call attention to Chile in South America, which lies upon the west slope of the Andes mountains, and which, although not exceptionally rich in minerals, still, because of a liberal progressive mining code, has a mineral production valued at more than 140 million dollars per annum. Contrasting this with Argentina, which is a country of more than double the population of Chile, and which lies upon the eastern slope of the same mountains, and has equally great mineral resources, and yet, because of a difficult code of mining laws has a mineral production of less than $300,000. As a further illustration of the great importance of the mining industry permit me to state that the western half of the United States was developed first for its mines; railroads were constructed, steamship lines established, and the large and important industrial communities of the West grew up around these mining centres and as a direct result of their activity. It is a significant fact that 60% of the business of all the railroads of the United States is derived from the products of the mines and quarries. These facts and the further fact that metals are greatly needed not only in times of peace, but in time of war for maintaining and defending a country's territory, are ample justification for a serious consideration of the question.

Mining laws, in order to be operative and just, should be brief, simple, clear, and uniform. They should be brief and simple because they are to be read and interpreted by individuals who have little knowledge of legal phraseology. In this connection permit me to point out that the Federal mining law of the United States, a copy of which I happen to have with me and enclose with this letter for your consideration, comprises only 28 articles and requires for its presentation but 9 printed pages. There has been considerable supplementary legislation and the Land Department has promulgated a considerable volume of regulations for the carrying out of the terms of the law, but the law itself is ideal in its brevity and simplicity. The law should be uniform so far as possible in order that the prospector may understand clearly the requirements and may not unwittingly make mistakes and fail to comply with the provisions of the statutes. Thus, if there is a different law for the location of copper and gold and iron, and other metals, confusion will inevitably arise.

The ideal mining law is one that protects the Government and the public interest on the one hand and at the same time protects the miner, and is so liberal in its provisions as to induce him to take the chances inevitable in the mining business and expend his time and money in search for and development of new properties.

The Government should be protected, first, by requiring a reasonable amount of development in each year. No individual or corporation should be permitted to hold indefinitely large tracts of land for mining purposes without making serious effort to develop the same, and to work the mines on a reasonable scale. The Government should likewise require as nearly constant operation as is consistent with economic conditions. On the other hand, the Government should not attempt to prescribe rigorously how much ore should be produced every year nor at what price the product should be sold. It is manifestly impossible to thus control economic laws. The owner of a good mine will work his mine to its maximum capacity whenever he can dispose of its product, but when marketing conditions are difficult and the price of metals is low so that the mine cannot be operated at a profit, he should not be required by law to continue to do so.

In the third place, the Government expects and should receive some revenue from its mines in the form of taxes

or royalty. By this I do not mean to imply that the Government should attempt to make large profits out of the operations of individuals or corporations. This has been a temptation in times past and has not worked out to the advantage of the community. A reasonable tax upon the product based either upon the valuation of the property or upon the net profit of the operation is always fair and cannot be objected to. But there are so many uncertainties connected with the mining industry that unless a large reward is possible the prospector and the miner will not exercise their activities. Furthermore, the benefits to the community and to the Government that arise from the development of mines in an indirect fashion is so much greater than that which could be derived by a heavy tax upon the mines themselves that it has now been generally accepted as true that a liberal policy produces the best results.

The miner must be protected in exclusive and undisturbed possession of his property. Many countries require an actual discovery of mineral in place before granting to the prospector any form of possessory titles. This practice is based upon ancient laws and customs. The more modern codes of mining law permit the prospector to stake his claim wherever he desires to prospect and protects him in his possession for a reasonable term of years so long as he continues in good faith to search for ore within his claim. The mining law of the United States requires a discovery before location, but this provision of the law will probably be changed in the near future.

The miner should have freedom of operation. He should not be unduly hampered by governmental restrictions and regulations. It has been my experience that the mining engineers employed by governments and given authority over the operation of mines owned by individuals and corporations are not nearly so well qualified to direct such operations as the men employed for the purpose by the mine-owners. There is in the United States no such supervision of mining operations by Government officials or engineers. The only control exercised is in connection with regulations for safety and health. It is my understanding that in Russia mines owned by foreign companies are compelled by law to employ Russian engineers as managers. I know of no other country where such a law prevails. It is apparent from brief consideration that such requirements are not only distasteful to the owners, but actually a handicap upon the Russian mining industry, since mining companies of large capital and resources, with well-organized technical staffs, are not likely to view with favor the installation at their mines of men whose qualifications are unknown to them.

The mine-operator should not be restricted in the marketing of his product. He should be permitted to seek the best market and make the best possible terms either at home or abroad. Referring once more to the United States I may be permitted to point to the fact that there is no limitation whatever upon the exportation of its mineral products, either raw or manufactured. Contrast this situation and the consequent magnitude of American business in iron and steel products with that of Brazil, where there exist the largest deposits of high-grade iron ore known in the world, and yet a condition of industrial depression certainly attributable to at least a limited extent to the refusal of the Brazilian government to permit the export of iron ore and other crude minerals. Look again at Sweden, where there exists one of the largest deposits of iron ore known today. This mine, at Kirunavara, contains enough iron ore to supply Sweden for more than 600 years, and yet the Government restricts its operation and production and thereby prevents extensive and large development.

The fundamental idea that I have in presenting these few considerations is that no pound of coal, or iron, zinc, copper, or lead is of value until it is used. It does no one any good to keep it in the ground. It is useless to fear for the prosperity of generations yet unborn. They will look out for themselves. The art of metallurgy and the use of metals are so constantly changing that no one can foresee what will be required centuries hence. Consequently the nation which makes the freest use of its mineral wealth, throwing it open most liberally to the initiative of the world's miners, is the nation which in the immediate future will benefit most largely through the possession of these mineral deposits. American capital, like the surplus capital from other countries, will go where it finds the best opportunity for employment and is promised the best return. Russian mines will be developed rapidly and extensively if the Russian laws are as favorable as those of other countries.

THE mineral output of Alaska in 1916 is valued at $48,632,138, being an increase of nearly 50% over the output of the previous year, which was $32,854,229. This increase has been due mainly to the activity in copper mining. The output of that metal for the year was 119,602,028 lb., against 86,509,312 lb. in 1915. During the year 18 copper mines were in operation, nine in the Ketchikan district, six in the Prince William Sound district, and three in the Chitina district. The average copper content of the ore mined was 9.7% and the value of the combined gold and silver content was $1.60 per ton. Twenty-nine gold-lode mines were operated during the year, and the production was valued at $5,912,736. The average value of the combined gold and silver content for all silicious ores mined in 1916 was $1.70. The value of the placer-gold production in 1916 was $11,140,000, an increase of $660,000 over 1915. This increase came from the newly developed Marshall and Folorana districts. During the year 139 tons of metallic tin, valued at $121,000 was produced, chiefly from the York district, in the Seward Peninsula, where four dredges were operated, two of which worked on gravels carrying gold as well as tin. Much stream tin was recovered from the placer deposits in the Hot Springs district. About 1500 tons of antimony ore, and about 47 tons of scheelite concentrate, including a little wolframite, was produced, mostly from the Fairbanks district.—Bull. 662 A, U. S. Geological Survey.

The Business of War

By CHARLES T. HUTCHINSON

Commercial United States doesn't know 'where it is at,' and no wonder! Proprietors of big business enterprises, presidents, managers, and what not, find themselves no longer in authority. They are order-takers, not order-givers. Our Uncle Samuel is the one and only order-giver. Take thirty billion dollars, an inconceivable sum of money, chuck it into the manufacture of all sorts of material utterly foreign to peace times, and it is not surprising that most people find themselves at a temporary loss to see anything farther ahead than the exigencies of the moment.

Nevertheless, it will not take long for business to accustom itself to the new channels, although it may be rough going for a few months longer. As military needs become more clearly defined and standardized, and as requirements whether of men, ships, ordnance, or supplies become resolved into definite quantities within definite time, business men will be able to see what proportion of their product they may devote to maintaining their hold on former customers. As it is, the digestive apparatus of commerce is trying to assimilate an altogether new diet. A certain amount of economic dyspepsia, under these conditions, is not surprising. This condition is most pronounced in the great manufacturing districts. New York is the focal point, the nerve-centre of the War's industrial activities, while Washington, only a few hours away, issues its mandates to the captains of industry. From one end of the country to the other everybody's doing it, and doing it with a will too. There are no half-way measures about the American manufacturer. "Any part, or all of my output is at your disposal." That is the way they talk, and that is the way they act.

Some twenty years ago, we had a slight unpleasantness with Spain. In those days the country's need was regarded as the business man's opportunity. The vendor of obsolete transports, embalmed beef, shoddy uniforms, and adulterated medical supplies clustered around headquarters like flies. An altogether different man is clustering today. His job is to give rather than to take. Those who have private means are working for nothing; those who haven't are giving their services for a fraction of their earnings in civil life, while big and small industrial enterprises are, in large part, giving up their normal lines to devote their productive capacity to Government needs. Of course, there is some profiteering. This is not the millennium. Such profiteering as there is, is relatively small and unimportant. There are parasites who, possessed of some capital, are hoarding foodstuffs, especially such necessaries as sugar, and are plying their nefarious trade through back alleys and behind closed doors, selling in small quantities at famine prices to those whom necessity makes an easy prey. If that class of profiteer could only be reported to the nearest office of the Food Administration their activities would soon be stopped. Another kind of profiteer is going into the market, buying anything from scrap-iron to tin-plate, wherever he can find it, and taking his chances of being caught and his stock commandeered by the Government. This might be regarded as legitimate speculation, and so it is except during times such as these, when such materials are so urgently needed by the Government for a more urgent purpose.

Then there is the inn-keeper, whose activities are most pronounced in New York City. He deserves a paragraph to himself. His menus are decorated with the slogans of the Food Administration. The victim, whose business compels him to visit the metropolis, reflects upon the all-pervading spirit of patriotism, until he sees the prices. That is the first shock. The second comes when he views the size of the portions. Apparently patriotism has enabled the Boniface at one time to increase his prices about 25% and decrease the size of portions another 25%. Glorious economy! Splendid patriotism! It has been said that the saving in foodstuffs has aggregated some thousands of tons monthly, and elicited the commendation of the Food Administrator himself. Here we have economy de luxe, while the ultimate consumer, scorned as usual, folds his tent and silently steals away, all the while trying to devise ways and means of camouflaging his expense account.

The most stupid profiteer of the lot is the man who, placed on his honor in the execution of a war contract without fixed price, renders a bill carrying an exorbitant profit, with the thought that he won't be caught at it. Here is a case in point. The execution of a certain order for war material was placed with a manufacturer. In due course the work was finished. Then came the bill. It amounted to $37,000. The engineer who was acting as purchasing agent made an estimate of cost at $16,500. He called in an independent engineer, who estimated $16,700 as the probable cost. A Government department made an estimate based on the cost of duplicating the work elsewhere. Their figure was something under $17,000. All the documents and exhibits in the case were forwarded to the powers that be. Something is likely to happen to that contractor.

Uncle Sam is an indulgent taskmaster, and will go to extraordinary lengths to help those who are 'on the level,' but woe betide those who are not. Manufacturers who have turned their entire plants over to the Government are practically working on a cost-plus arrange-

ment, generally 10%. They can't lose money on this basis. All they are asked to do it to devote their best efforts to the production of perfect work and material in record time. Others who are taking work at fixed prices, find that the Government will aid them in obtaining materials at costs that would be impossible for the execution of private contracts. Then, again, contracts are made based on the costs of labor and material at the time the contracts are executed, and subject to adjustment for any fluctuations that may take place between commencement and completion. What could be more fair?

The Government has at its disposal any quantity of expert engineers, estimators, cost-accountants, and other specialists who are devoting their time to see that work is well done, and that the expense is in keeping with present conditions of labor and material. The Government will not knowingly pay for defective work any more than a private individual.

There are two divisions of work in this country today: that which is directly contributory to the conduct of the War, and that which is not. The two basic industries, agriculture and mining, are in demand as never before. Lessons taught us by the experience of our Allies have been taken to heart. Governmental supervision of both these great essentials is already an accomplished fact, and while the administration of both is still in process of development in many details, yet the foundation is there and the rest will follow, it is to be hoped, with as few blunders as possible.

Industries not directly or indirectly pertaining to war-needs will suffer, and in some cases, cease altogether until Victory perches on our banner. Work will be available for all willing men and women, perhaps at something other than that to which they have been accustomed, but work nevertheless, and at record high wages. The labor problem is not to find work, but to make those work who don't want to work.

Governmental assumption of power to fix prices must be extended to the fixation of those elements that make costs. The one element of uncertainty is labor; in fact, in the labor situation lies at once our greatest strength and greatest weakness. Enemy propaganda is doing its utmost to attack us at this point, and it is to the credit of far-sighted labor-leaders like Samuel Gompers that thus far our productive capacity has not been materially impaired. If the elements entering into the cost of living can be held within reasonable bounds, so, in turn, can the question of wages be settled. As it is, wages in some trades would be attractive to bank presidents, while the clerks, book-keepers, salesmen, and other members of the unorganized 'submerged tenth,' between the upper and nether millstones of low pay and the H. C. L., are being ground to dust.

What is more serious than wages is the tendency on the part of the workmen to limit output. This evil has been growing for years, and, according to some investigators, is worse now than ever before. To discover the cause involves an investigation of industrial conditions for many years back. In a few words, it is the effort of labor to fight one evil with another. Not so many years ago, capital operated on the principle of get all you can in exchange for as little as possible. Labor has adopted at least in part this same principle. It is defenseless. Capital was the first to see the light. Whether this improved vision is due to higher morality, or whether it was forced by the growing strength of the labor-unions is of little consequence. It is sufficient to consider conditions as they are today, and that is that the capitalistic boss has been succeeded by the labor boss. Neither is for the best interest of the Nation. Both represent the quintessence of selfishness—a selfishness that, in view of the country's present need, is treason.

Some of the more advanced thinkers among labor-leaders, notably Samuel Gompers, are trying to stem the tide that they themselves started. Certain it is that conditions will not improve without the active co-operation of labor-leaders, great and small, who will join with employers in doing their utmost to point the way of duty and patriotism. There is even a greater need for the co-ordination of the forces of labor than of the Administration at Washington. Every man who calls himself an American should be made to realize his responsibilities in this great struggle of struggles. Every one of us is an integral part of the fighting force of the United States, whether he be clothed in olive drab, navy blue, or the unsightly but practical overalls of the workman or farm-hand. There is no five o'clock whistle on the Hindenburg line. There are no Saturday half-holidays at Essen. We have to defeat a nation in arms, and only by a greater nation in arms can it be defeated.

Before long the war-after-the-war will receive attention. It is receiving attention now from the more far-sighted business men, who can see farther ahead than the ends of their dignified noses. In the conduct of a successful business enterprise, brains and money are spent lavishly in the creation of that intangible something known as 'goodwill.' Many have tried to describe it, many have tried to capitalize it, and many have made a hash of it, nevertheless there is no such thing as business success without it. It is, in effect, the feeling of confidence and security that forms the invisible connection between those who serve and those who are served; that depends, for its maintenance, upon continuous upkeep in good working order. It is the continuous upkeep of it that, in these days, is the sticking point. "How am I going to serve my old customers when the Government is taking 85% of my output?" said a distracted manufacturer a few days ago. This question may be answered by reciting the policy, if it may be so called, of a prominent manufacturer of certain specialized apparatus, whose output for the next two years is all sold for war purposes. Inquiries for the purchase of his apparatus continue to come in at an even greater rate than before the War. Every inquiry is answered promptly, stating, on the all-important question of delivery, that the condition of the market will be carefully examined and a reply sent as soon as possible. Then he carefully

canvasses all possible sources of supply, including every factory for apparatus similar to his own, all second-hand apparatus that may be in serviceable condition, and other apparatus that, in a pinch, might be used as a substitute. This information at hand, he is able to serve his customer, with apparatus other than that of his own manufacture, perhaps, but nevertheless the customer gets what he wants, and during these times will remember the man who did not desert him in his hour of need. Where nothing can be done, the manufacturer's willingness to help counts for a great deal, and will not be forgotten when the War is over, and everybody will be scrapping for orders in the good, old, time-honored way.

The British manufacturer has learned his lesson, and is looking far ahead with an eye to what will come afterward. The pictorial British weeklies carry practically as much advertising as they did before the War. It is many months since English manufacturers of automobiles have been able to execute an order for any private party. Nevertheless they are giving as much space as before to setting forth the merits of their product, its improvements, its record in the war-zone, and soliciting orders to be filled when the War is over. The same is true of class and trade publications. Our London contemporary is carrying as much, if not more, advertising space than before August 1914.

There is nothing so dead as that which is forgotten. American manufacturers will do well to ponder over this statement and remember its truth. There is no excuse for lack of attention to civil inquiries, even if nothing can be done with them at present. The commercial fabric of the Nation must be preserved, and the holes patched up, for the trade and industrial war that is to follow the present physical struggle will be waged none the less bitterly and relentlessly from the fact that bloodletting will have ceased.

Many manufacturers think they are worse off than they really are. A few inquiries or orders that for the present cannot be filled stampedes the herd. If the salesmen would put in their time trying to obtain what is wanted from any available source, they would earn their pay through the maintenance of their employer's goodwill, and lay up for themselves treasures untold when the day of reckoning comes, as it surely will. After it is over, this war will bring about a separation of the industrial sheep and goats. Those who regarded their temporary prosperity during war-times as a permanent institution will collapse like pricked balloons when Governmental orders have ceased, unless they maintain their connection as best they can with those whose business they formerly solicited so eagerly. "We are so well-known that they will surely come back to us" is a dangerous viewpoint. Customers are fickle jades, as a rule, and the continual receipt of the weekly bunch of violets is more effective than the occasional splurge of a box at the opera. Nothing is so irritating as unanswered mail, especially when the man whose letters are unanswered is sitting on a red-hot stove waiting, hoping against hope, that a needed replacement will arrive and enable him to go on with his work.

Metal mining is a war-necessity, and the machinery required should rank high in the rulings recently established by the Priority Board. Mining-machinery manufacturers and dealers in supplies for mines are doing their best to meet the requirements of their customers, while, at the same, building everything from ships to munitions for war purposes. Many factories are running at 100% load-factor for the first time in their history, while some are operating at as high as 200% overload. Here is a chance for the real efficiency engineer. The cry is always for tonnage, and yet more tonnage. In civil life the element of cost is paramount. In military life, it is the element of time. Cost is secondary. To hasten the end of the War a month, a week, a day, or even an hour, is to save untold wealth in human lives and energy.

One is proud of the way American business is putting its shoulder to the wheel. We know nothing definite as to the progress that has been made. There are military reasons why we should not. Nevertheless notes of cheer are heard above the din of battle. It seems that several submarines have gone to their final resting-place. Several ships flying the American flag are on the high seas, a novelty in maritime circles. Several American soldiers are now in France, and more are to go. Congress is in session, and may do something to the second-class postal-rate increase that will give the publisher a fighting chance. We have wheatless days, meatless days, and some of us are having sleepless nights. Nevertheless we are proud of our nation, the cause it has espoused, and are firm in the conviction that American brain, brawn, and dollars will supply the impetus that will give the finishing blow to Attila and his Huns.

JAPANESE steel production is increasing rapidly. Through recent investigations by the Mining Bureau it is learned that the total producing capacity of Japanese steel mills was 888,000 tons, in round figures, at the end of August. During the first half of the present year 289,000 tons of various shapes were produced exclusive of the colonies. Of this amount 200,000 tons came from the Government Steel Works. The Japan Steel Tube Co. turned out 22,000 tons; the Japan Steel Works, 14,000 tons; the Kawasaki Dockyard Co., 12,000 tons; and the Kamaishi Steel Works, 10,000 tons. By the end of this year the products of those mills will reach at least 570,000 tons net. Compared with the preceding year this is an increase of 50%. If this rate of increase is maintained, next year will see a further increase at least to 850,000 tons net.

PLATINUM has been found in basic rocks in many parts of the world. Chromite is also common in similar rocks, and consequently it is sometimes accompanied by small amounts of platinum, in one case, reported from South Africa, the amount being 1 dwt. per ton.

Joplin and the Komspelter Region

By OTTO RUHL

The past three months has represented a period of re-adjustment in the zinc and lead districts of Missouri, Kansas, and Oklahoma; it has been one of the most severe from the point of view of strained credit, wholesale closing down of mines, and even abandonment of some localities ever experienced, with perhaps the single exception of 1907. This is partly brought about by low prices and partly by gradually rising costs of production. The only relief in sight has been the transfer of operations from the low-grade properties to the high-grade, a relief often obtained at great sacrifice and disorganization of working-forces. The transition from a prosperous industry in 1916 to a fight for existence in 1917 has been marked by many struggles. Nevertheless the momentum of the highly prosperous times of 1916 and the earlier part of 1917 has been such as to carry the annual production for lead and zinc to new high levels, and records have been made that can hardly be expected to be attained again for some time. Eleven months of 1917 shows an increase of 100,000 tons of zinc concentrate over 1916. The increase in lead concentrate is 11,835 tons. The increase in zinc was over 34% and the increase in lead 25%. The net increase in value for the two products is $5,000,000 on shipments alone, and to this must be added the surplus in the bins, totaling 33,000 of zinc concentrate and 8500 tons of lead concentrate. All of this increase was made in the face of a decrease in the average price of zinc concentrate. This decrease amounted to $9.18 for blende concentrate and $27.30 per ton on calamine concentrate. The increase in zinc prices therefore has come from the gain in tonnage, and not in price. The increased value of $19.11 for lead concentrate comes from both an increase in price and an increase in tonnage.

The falling price for zinc concentrate and the rising prices of supplies and labor have steadily ground down the operators in sheet-ground until every item of profit has been extinguished and the balance, in many cases, is on the wrong side of the ledger. Only in a few instances, where units of operation were large and where the percentage of extraction was high, have they been able to hold out. Out of 150 mills in the sheet-ground district, around Webb City and Carterville, one can count on the fingers of two hands those that have survived. Even these may succumb; the end of the year may see further additions to the plants closed-down or removed to other localities. This will wipe out a district that supplied 50% of the entire production of the region, a production that ranks as high-grade and that apparently cannot be replaced elsewhere in the United States.

The impossibilty of replacing this output is recognized by all. The concentrates are free of any lead or contain extremely low percentages of lead, making them highly desirable by smelters engaged in the manufacture of sheet-zinc or for some classes of 'brass special' spelter. A large proportion of these concentrates would assay 60 to 63% zinc, 0.005% lead, and 1% iron. Only mines in parts of Joplin and Alba Neck City would show the same degree of purity elsewhere in the district. On the other hand, throughout the year there has been a steady growth in a mill-product that runs 58 to 60% blende, 1 to 1½% lead, and 2% or better in iron. It is evident from the trend of production that no such tonnage of high-grade ore can be expected from any part of the region now showing increased development. If anything, the grade is likely to be lower than higher.

The only locality where high-grade ore is being developed is at Waco, north of the old Lawton mines. Here a number of new mills are yielding high-grade concentrates. The ore itself is not only rich but of good quality, and while the developments have not yet reached such a stage as to ensure a large production the mines already developed, together with the drilling now in progress, offer considerable promise for the future. The whole trend of development has been going toward the Oklahoma portion of the region, and the work already done may be rapidly extended north-east of Picher as far as Crestline, Kansas. One of the recent developments has been the testing of the Newton farm, east of Crestline, the results of which were so promising as to induce the American Metal Co. to pay $78,000 for the tract. The development by the Union Metals Co. at Waco seems to be extending the productive area south-westward and north-westward so that a possibility of a continuous line of operations is now within the realm of possibilities from Picher, Oklahoma, to Asbury, Missouri. A large number of drills are now being placed on the Missouri side near Asbury with the idea of testing that portion of the prospective mining area. The year therefore has seen a tremendous development of new territory covering portions of the States of Oklahoma and Kansas with the promise of this same extension of development into Missouri at the northern end of the line.

Coincident with this prospecting and development work has been an era of mine investment that has not been altogether sane. The richness of some of the mines has induced the pyramiding of royalties. On top of the high royalties have come the gradual paying of higher prices for leases until there have been sales well above the million-dollar mark in single units, and some sales

have been reported as high as $2,000,000 where combinations of properties were made. It is doubtful whether many of the high valuations can be justified. Gradually there is growing a better sense of values, but this better sense has come rather from the shock of a falling ore-market and the realization that exploitation in the new district curtailed the highest cost of production in the entire region, and that conditions were growing worse instead of better owing to the increasing cost of material and the growing inefficiency of labor. The latter is an extremely serious factor. It has been brought about by the unusually large number of new mines that have come into operation so quickly as to require large numbers of laborers. The constant bidding of one concern for men has tended to raise the price of labor and to lower its efficiency. This condition has extended even into the older settlements until it is no uncommon thing to hear a mine-worker say at Webb City: "They will pay me $5 a day just to stay underground in the Oklahoma district, so why work up here." Conditions have gotten far beyond the control of the mine-operators in this respect, and while there is undoubtedly valid reason for paying higher wages at Picher, there is none for the failure to receive an increase in actual labor performed. If the operations showed the same efficiency in the Picher area as they do in the sheet-ground area of Webb City, the cost of production would not only be much lower than it is, but the production also would be greatly increased.

The opening of the winter season totally disorganized both railroad and highway traffic throughout the new mining area extending from Commerce, Oklahoma, to Baxter Springs, Kansas. In the very midst of repairing the rock highway between Joplin and Commerce came 18 inches of snow accompanied by cold weather. This, followed by thawing with heavy truck traffic over it, has been very disastrous and the highway is in an extremely bad condition. Very heavy traffic will be considerably delayed until such period of time has elapsed over a dry season to make possible the repairing of the damage already done. So far as dirt roads running off the rock highways are concerned, they have been impassable for the past ten days. This precludes any possibility of hauling coal to the mines or hauling ore away from them. These conditions have also seriously interfered with labor getting to and from the mining properties and their homes. Production here therefore suffered greatly for the past ten days and there is little hope of improvement for another fortnight at least. Both of the railroads into Oklahoma district are new. Their roadbeds have not been settled and the heavy snows have demoralized traffic over the railway until the efficiency is very low and little improvement can be expected here during this winter. In view of the prevailing conditions there can be little increase in output during the coming three months from the new district and it is doubtful if it will hold its own during that period if road conditions are not improved and a better supply of cars becomes available for coal-supply and the transport of ores. Already the mill-bins are full and it would be surprising if shipping conditions are improved sufficiently in the next quarter to take care of this surplus. Unless this surplus is sold operations can hardly be financed, except by one or two strong concerns. This will act as a brake upon production during winter. An estimated output of 5000 tons per week from the new district during the next three months is believed to be conservative. The coming of the spring, however, will see a notable increase, if the market is favorable and fuel is available.

A Substitute for Corrugated Iron

The British, in their efforts to practice economy in the use of steel and iron, have developed and are now manufacturing a satisfactory substitute for corrugated iron and sheets. It is an asbestos-cement roofing material. During the last year a large plant has been built in England for manufacturing this product. The method of making it is as follows: After being finely ground and freed from extraneous matter the asbestos, which acts as the reinforcing agent, is mixed with portland cement in the proportion of about 1 to 6, and made into a paste with water. This paste is then taken to a machine of the paper-making type, where, on a large revolving drum, it is formed into sheets or felts. After the sheets have been trimmed to size, they have the corrugations impressed on them. The important condition for this operation is to insure that the tops of the corrugations are as strong as the other parts of the sheets. Finally the sheets are subjected to a 'seasoning' process. The corrugations are made to the 3-in. pitch which is usual with corrugated-iron sheeting, not to the 2½-in. foreign pitch, and they can therefore readily be used to repair roofs of corrugated iron. One of the chief advantages claimed is their durability and resistance to climatic conditions, especially to an acid-laden atmosphere, which rapidly destroys corrugated iron. The sheets are also fire-proof and are poor conductors of heat.

Brazilian manganese shipments, which, owing to the closing of other sources of supply, are now being made in large quantities to the United States, amounted to 245,088 tons having a declared value of $5,733,000 during the first six months of 1917. The chances are that these will largely increase if the Brazilian railroads which carry the cargoes from the interior to tidewater and the conditions of South American shipping are able to cope with the increasing demand.

The British Minister of Munitions has forbidden, except under permit, all dealings or proposals for sale of tungsten or molybdenite ores, and will fix maximum prices at which these ores may be bought or sold. Applications for permits to export to allied countries must be made through La Commission Internationale de Ravitaillement, India House.

Manganese at Butte, Montana

Manganese is abundant in most of the lodes at Butte, Montana, heretofore worked for silver and zinc. In an area of about five square miles that surrounds the principal copper mines on the north, west, and south-west, all the lode outcrops are black with manganese oxides, and in the workings that penetrate below the oxidized zone there are deposits of rhodochrosite and rhodonite, minerals containing manganese.

A reconnaissance of the Butte district was made recently by J. T. Pardee of the U. S. Geological Survey, who reports that the development of manganese ores at Butte has heretofore been wholly incidental to the production of silver, zinc, and lead, in the ores of which manganese minerals are among the chief components of the gangue. Except a few small lots used for fluxing at the smelters, no manganese ore was mined for manganese prior to 1917. As ores containing less than 25% silica are rare in the district, the development of the lodes for manganese has lagged behind that in localities which produce ore of better grade. Systematic exploration of several of the larger manganiferous lodes has just begun, and search for pockets of marketable ore is being made in a small way by several lessees.

The manganese ore is mostly oxidized and silicious, and its content of manganese ranges from 10 to 37%, but there are small quantities of high-grade ore, both oxide and carbonate. Of the higher grades of ore small bodies that contain 40% or more manganese in the form of oxides, chiefly pyrolusite, occur in most of the lodes, but this ore generally carries a rather high content of silica. At several places near the surface, however, there are pockets or lenses a foot or two thick and 10 to 50 ft. long containing less than 15% silica and 40 to 50% manganese. Other small bodies that occur in certain of the lodes contain about 40% manganese and 5 to 25% silica. These are oxidized ores, but below depths of 40 to 100 ft. the manganese oxides generally give place to rhodochrosite and rhodonite, which are found down to the limits of exploratory workings. The carbonate and silicate ores are generally intimately associated with quartz and with sulphides.

The medium-grade ore occurs in bodies that contain 20 to 37% or more of manganese. They range in length from 50 to 400 ft. and in width from 1 to 35 ft. Their minimum depths or pitch-lengths, as shown by the surface workings, range from 10 to 80 ft. Persons familiar with the deeper workings, which are not now accessible to examination, say that manganese oxides occur at one or two places to a depth of 200 ft., but that they generally give place to pink manganese carbonate at depths of 40 to 100 ft. below the surface.

Material containing less than 20% manganese forms the larger parts of many lodes. This material is probably of too low grade to be considered ore at present, but it may be regarded as a possible future resource.

Incomplete estimates of the manganese oxide ore in the Butte district, in which Paul Billingsley and A. C. Grimes co-operated with Mr. Pardee, may be summarized as follows:

	Tons
High-grade ore, low in silica	1,000
High-grade ore, silicious	1,600
Silicious ore with 20 to 37% manganese	130,000
Silicious ore with 10 to 18% manganese	270,000

A common variety of the ore is rather coarse-textured, showing irregular interlocking masses of manganese oxides and quartz. Another variety is coarsely cellular, with criss-crossed partitions of pyrolusite in a skeleton or honeycomb of quartz. Ore of these varieties could perhaps be easily milled. A third kind, not so common as the others, is compact, fine-grained, and rather jaspery, and all gradations occur between the three types mentioned.

The main problems to be solved before Butte can become a factor in the manganese market under present conditions are (1) successful milling of the ores to produce a low-silica concentrate, and (2) briquetting the concentrate or otherwise making it acceptable to buyers. Milling tests have already been begun, but the results have not been entirely satisfactory, owing chiefly to losses in the tailing by sliming. Methods of concentrating manganese ore are now being studied by the United States Bureau of Mines.

Labor has become the largest cost-factor in productive industry and seems likely to continue its relative increase. The ideal of industry is a laborer who is sober, efficient, and steady. The first is in progress of attainment by the advance of prohibition of the liquor traffic. Efficiency in the workman is attained through better management and training of the worker. Lost time is overcome by the prevention of accidents and illness, and through a great variety of means that bear indirectly, as indicated above, on the labor supply. Industrial-accident prevention looms large in the public eye through the recent enactment of compensation laws, but as a source of lost time to the plant and lost wage to the worker it is much less important than illness. Health insurance is now being urged in many quarters, and if it comes about we may expect a transfer of emphasis from accident to illness prevention. Lost time through religious holidays and other personal activities, or inactivities, of the worker is much more important than either; their relative values being something like 1, 4, and 10, in most cases. The only practicable means of dealing with the latter seems to be the offering of a bonus, over and above wages, to the workmen who lose no time each month. The underlying purpose of personnel work is to conserve the labor supply and decrease the net cost of productive labor. Personnel work is human engineering, it requires natural aptitude and special study and is not a field for the well-meaning amateur, especially the amateur who is unfamiliar with the peculiar problems of the industry in question.—Thomas T. Read, Trans. A. I. M. E.



MAMMOTH, UTAH

PANAMA MINING.—TINTIC DRAIN TUNNEL.—TINTIC OUTPUT.

John E. Brown closed a contract to haul a large tonnage of uranium ore in Dry valley to the railroad at Thompsons, where a warehouse is being built to receive it.——With a view to reaching the Cardiff contact as quickly as possible, the Tar Baby has left the fissure which has been followed for some time and is driving directly east.——Fred McCoy, who has been engaged for a number of years in the development of his property at Beaver basin, on the north end of La Sal mountain, has formed the Panama Mining Co. Attention was drawn to this property during the month, when Mr. McCoy shipped a car of rich copper ore to the Salt Lake smelters. The returns showed 27½% copper and 37 oz. silver per ton. The property controlled by the new company comprises 280 acres of valuable copper claims, situated in the Beaver basin. There are large bodies of low-grade lead ore which the company intends to develop. The high-grade ore that has been mined is found at water-level in a well-defined vein. The company has a capital of $100,000, part of which will be spent in the erection of a small mill.——The Central Standard Mines Co., operating in the eastern end of the district, has levied another assessment of ½c. per share.——A shaft accident at the Chief Con. delayed work during the early part of the week; one of the tanks used in bailing water caught in the shaft and tore out several feet of guides.——Joseph S. Wing, of Springville, and associates are testing the oil-shale near Millfork at Spanish Fork canyon. They have located 400 acres. Herman Harms, the State chemist, is now making an analysis of the shale.——Satisfactory work is being done at the plant of the Tintic Milling Co., which treats 250 tons per day and produces 50 tons of bullion per month.——Henry Barney, who is superintending the work at the Tintic drain tunnel, says that by the first of the year the machine-drills will be operating in the face of the tunnel. Work is proceeding by hand in a loose formation.——A large engine will be erected by North Beck Mining Co. shortly. The equipment now in use is not heavy enough for deep work and consequently will be replaced with the larger hoist when the shaft reaches a depth of about 500 feet.

McCarthy & Price is shipping three car-loads of manganese ore per week from the Chief Consolidated lease. The ore carries 38 to 39% manganese and is being shipped to the steel manufacturers in Pennsylvania. McCarthy & Price has succeeded in opening a second deposit of manganese, which is about 200 ft. from the main discovery; it is possible that the ore will be found to be continuous between these two points. The deepest workings are less than 100 ft.. McCarthy & Price has leased another deposit of manganese in the West Tintic district from which shipping will soon begin.——The annual meeting of the Grand Central Mining Co. will be held at Provo on January 8 when new officers will be elected and other business transacted.——During the week ended December 22 the mines of the Tintic district sent out 197 cars of ore compared with 206 the previous week. The shippers were Dragon Consolidated 51 cars, Eagle & Blue Bell 24, Chief Con. 16, Centennial-Eureka 14, Grand Central 13, Mammoth 12, Tintic Standard 9, Victoria 8, Colorado 7, Gemini 6, Gold Chain 6, Scranton 5, and Empire Mines 2. The combined shipments of the other nine mines makes the total of 197 cars.——The appearance of considerable water in the bottom of the shaft at the Eureka Bullion is believed to indicate that the bottom of the cave, which has caused a great deal of trouble during the last few months, is near at hand. Heavy talc is also appearing in the bottom of the shaft, along with large boulders of foot-wall material, containing manganese, barite, and iron. Small bunches of gray carbonate also are reported to be coming in and the management is confident that the work is approaching a big carbonate orebody. The shaft is down 640 feet.

TORONTO, ONTARIO

DOME.—HOLLINGER.—MCINTYRE.—KIRKLAND LAKE.—NIPISSING.

The closing of the mill at the Dome Mines has been followed by the suspension of operations underground. Most of the men who have been laid off have remained in Porcupine and relieved the situation in other mines. Development, it is understood, will be resumed at the Dome in January under the contract system and will include the sinking of the shaft to the 1500-ft. level. The directors anticipate that the mill will be started again in the summer to crush some 300,000 tons of $6 ore now in the stopes, which cannot be extracted until all the ore overhead has been broken down. This, it is estimated, will yield another 100,000 tons.——The statement of the extent and value of the orebody recently discovered in the 400-ft. level at the Millerton section of the Hollinger was received with some incredulity, and it was feared that the figures had been considerably exaggerated, but during a visit of the directors early in the month all doubts were set at rest. The vein has a width of 71 ft. with an average gold content of $28.60 per ton.——Rich ore is being found in the lower levels of the McIntyre. The drift across the McIntyre Extension at the 1000-ft. level is in a large orebody in the Jupiter area, said to be 50 ft. wide and to carry about $10 per ton. An electric-haulage system is being installed on this level to facilitate the handling of the ore. Extensive diamond-drill operations are in progress.——The Crown Reserve is energetically pushing the development of the Newray, where one vein 30 ft. wide is yielding upward of $10 per ton. The mill, which is being used as a testing plant, shows a mill-head of about $10.——The McEnaney has tapped three rich veins in cross-cutting on the 100-ft. level. Diamond-drilling will be undertaken to prove at depth a 16-ft. vein supposed to be an extension of the big Millerton vein of the Hollinger.

The shareholders of the Teck-Hughes at Kirkland Lake have endorsed the proposal to raise funds for further development and the enlargement of the mill by increasing the capitalization from $2,000,000 to $2,500,000. The new issue of stock will be offered to the shareholders at 30c. per share.—— The cross-cut of the Kirkland Porphyry on the 170-ft. level has been in ore for 32 ft.; the formation is similar to that of other mines in the camp. The shaft will be continued to the 300-ft. level.——The Temiskaming, of Cobalt, is preparing to develop the Horne and Grazelle claims adjacent to the Kirkland Lake mine.——The Canadian Kirkland has put down two shafts, one of which, at 30 ft., is on a 16-ft. vein showing visible

gold.——The Aladdin Cobalt has arranged to use the mining plant of the Sylvanite for carrying on underground work on the Burnside property, which it acquired recently.——Most of the machinery for sinking the shaft at the Elliott below the 300-ft. level is in place. The vein, which is probably a continuation of the Kirkland Lake vein, is 12 ft. wide on the 300-ft. level with ore of commercial grade.

The Mining Corporation of Canada has started to develop the claim recently secured in the new camp of Rickard township. A mining plant will be erected as soon as possible, and two diamond-drills are on their way to the property. The surface showings are rich and the veins are of considerable size.——At the Murray-Mogridge mine, at Bourkes Station, the drift of the 200-ft. level is in 120 ft., the vein continuing a good width with high gold content. The fault, found on the upper level, has been cut on the 200-ft. level.——During November the Nipissing mined ore of an estimated value of $305,572, and shipped products from its own and customs ores of an estimated net value of $331,196. The production for the year will establish a new high record, the total value of the output for the first eleven months being $3,018,280, as compared with $2,920,714 in 1913, the banner year in the company's history.——The shareholders of La Rose Consolidated, the holding company, with an American charter, have authorized its dissolution and the distribution of the assets of the company, consisting of the shares in La Rose Mines, the operating company, among the shareholders. The capital will be reduced from $6,000,000 to $1,500,000 and the exchange will be made share for share.——The McKinley-Darragh has closed the re-grinding and flotation plant for treating tailing for the winter. It is proposed to substitute tube-mills for the present re-grinding equipment.——The re-modeled mill of the Provincial is giving good satisfaction, the tailing from the dump yielding 12 to 14 oz. of silver per ton. The mine has an entensive tonnage of medium and low-grade ore blocked out.

HOUGHTON, MICHIGAN

Isle Royale.—Michigan.—Mohawk.—Osceola.

The transfer of the railway service for the Mohawk and Wolverine mines, between the mines, mills, and smelters, from the South Shore subsidiary interests to the Copper Range interests, was concluded last week and the Copper Range now handles the business. This was one of the biggest railway deals that has taken place in the copper country for a number of years.——Nothing more is heard of the rumor of the absorption of the Isle Royale by the Calumet & Hecla. Now that the stock can be purchased in the open market for $21 per share, it would seem to have been a bad error in judgment if the Calumet & Hecla had agreed to pay twice that figure. Today Isle Royale is operating on a larger ore-tonnage basis than ever before, and is maintaining its underground openings substantially. With a normal market condition and a normal copper price and production price Isle Royale would be attracting as much attention as any other mine in the district. ——A 1000-ton test of the Michigan stock-pile showed 20 lb. per ton, not counting mass copper. It is believed that the rest of the stock pile will show just as good results. Underground openings in four different places are being carried forward, showing a good class of formation.——Franklin is sinking to the 18th level on No. 2 shaft. The best ore is coming from the Pewabic lode to the north where a good shoot apparently is opening. Ore tonnage continues 1000 daily.—— Lessees of the Winona are getting out 420 tons per day, mostly from King Phillip No. 1, but some from 3 and 4 Winona proper. The mill is handling 150 tons per day from South Lake.——At Mohawk, December likely will show an increase both in ore tonnage and in copper output. New ground opened in No. 1 shaft is better than it has been for some time past. Cross-cuts to the west show a series of small amygdaloid formations that are so good they are being investigated. Mohawk is shipping 2200 tons daily; Wolverine 1200. Wolverine has re-modelled its shaft-houses to accommodate the 50-ton cars now in use.——The Phoenix is the only property of the Keweenaw that has been operating for several years. When work suspended a few weeks ago it was understood that the suspension was temporary. But the pumps are being removed, which looks like permanent abandonment.——The most important news item of the week at any of the Osceola mines is the notable increase in ore output at the Kearsarge mines. Osceola now has a larger force than at any time during the year. For a week steady they got out 110 cars of ore per day, 3750 tons average from the Kearsarges; No. 3 North Kearsarge is showing a steady increase.——Locomotives for use underground at the Calumet & Hecla are helping to care for the trammer shortage, and the tonnage will soon be over 10,000 per day if present increase is maintained.—— At South Lake the ore is running 18 lb. per ton and the Butler lode, which is being stoped from three places, is showing a lot of nugget copper.

PLATTEVILLE, WISCONSIN

Vinegar Hill Zinc.—National Separating.—Grasselli Chemical.

William N. Smith, general manager for the Vinegar Hill Zinc Co., says the labor situation at present is much improved; negroes have been introduced into the southern districts of the field and applied to common labor and shoveling at the mines, which has tended greatly to release the more experienced for the better classes of mine work.——At the Meloy mine, owned and operated by the Vinegar Hill, electric mining-shovels are employed, which, it is claimed, are doing the work of 20 men.——At the Jefferson mine, in the Hazel Green district, a newly developed property and now fully equipped, a heavy overflow has been struck and the pumps are lifting 2100 gallons of water per minute. The mine is about drained and underground work will be in full swing before the first of the coming year. A new 800-gal. Pomona pump is being placed in the main hoisting-shaft. Double-compartment self-dumping cages are used for hoisting and 1½-ton cars will be used underground in connection with electric shovels. An exceptionally good showing is being made by the Vinegar Hill at both the Graham and North Unity mines, in the Galena district, where colored labor is largely employed.——In the Mifflin district the Yewdall and Senator mines are operating steadily with about 100 men, making a daily recovery of from 55 to 70 tons of zinc concentrate. The Rundell orebody, fully proved on adjacent lands by drilling machines, will remain undeveloped until market and cost conditions are more favorable. The company is engaged in joint drilling operations with the Grunow Mining Co., on the east boundary of the Senator lease. Several drills are employed at the company's mines in the Benton district, but strikes have been few except on the Copeland lease near Shullsburg.

The National Separating Co. of Cuba is handling 200 tons of raw concentrate every 24 hours averaging 29.32% of zinc. This yields 100 tons of finished blende ore assaying 60.54%, the bulk of which is sold in open market to the highest bidder. Shipments are made weekly to the Illinois Zinc Co., Grasselli Chemical Co., and the American Zinc Co. of Hillsboro, Illinois. A new Cottrell electric dust precipitator is being installed. Warehouses, machine shops, assay laboratory, and truck garage have been added to the big plant during the month. The Vinegar Hill Zinc Co. is giving employment to 500 men. The completion of an industry spur into the New Diggings district the first of December proved immediately beneficial to both the Meloy and Blackstone mines of the Vinegar Hill group and a big saving is effected in transportation of supplies and zinc ore.



ARIZONA

COCHISE COUNTY

(Special Correspondence.)—The new machinery at the Arizona Bisbee Copper Co. is now ready for operation, and sinking will commence immediately.

Bisbee, December 15.

MOHAVE COUNTY

(Special Correspondence.)—It is announced that the Schuylkill Mining Co. has accepted an offer to take over the Tennessee mine and that operations will commence immediately to open the orebodies that pass from the Tennessee into the Schuylkill ground.——A new company, the Standard Minerals Co., has taken over the Telluride Chief Mining Co. The ore is gold, silver, and copper, and carries some molybdenite.——The 64 claims of the White Hills Mining Co. are to be auctioned to pay a debt of $1200.——Active work has commenced on the Gold Road Bonanza. A station is being cut at the 500-ft. level.——A consolidation of the Liberty Bell Gold Mining Co. and the White Chief Mining Co. has taken place. Machinery from the Liberty Bell has been moved to the White Chief and a cross-cut toward the vein at the bottom of the 125-ft. shaft will be driven.——The Gold Ore is deepening its shaft another 150 ft. in order to further develop the orebody opened up in the levels above. A tramway has been erected between the mine and the Gold Road mill, where its ore will be treated. ——The first cross-cut through the recently discovered orebody of the Grey Eagle vein on the Tom Reed has been completed at 180 ft. from the point of discovery, showing 20 ft. of ore. It is estimated that the December production will be $60,000.——A splendid strike of ore has been made on the Morning and Evening Star mines 24 miles west of Kingman. ——Lessees on the Jamison mines in the Layne Springs section are shipping ore running as high as $100 per ton in gold, silver, and copper.——While straightening out the shaft between levels of the Walkover mine a fine body of ore running better than $50 per ton has been opened.

Kingman, December 22.

PIMA COUNTY

(Special Correspondence.)—A. W. McCuen, of New York, representing Morgan and Frick interests, has taken an option on the Silver Queen group of claims, 35 miles north of Tucson, and has commenced drilling.——Roos & Tovote have purchased the smelter at Socorro, New Mexico. The smelter will be dismantled and shipped to Tucson, where it will be erected as a custom plant. It will handle 250 to 300 tons per day.——Prospectors have located extensive scheelite deposits along the range of the Gunsight mountains, near Ajo. These deposits, together with the recent discovery of gold placers in the same district, are causing a considerable rush.——Machinery for a mill to treat wolfram ores on the Canada Del Oro claims, 30 miles from Tucson, is being shipped.——The Greater Ajo copper property, composed of 64 claims, will be taken over shortly by Eastern mining capitalists.——The Stratton Copper Co., in the Old Hat mining district in the Catalina mountains, has been taken over by the Old Hat Mining Company.

Tucson, December 17.

PINAL COUNTY

(Special Correspondence.)—Water has been lowered in the old Silver King mine to the 220-ft. level. On the 250-ft. level several drifts are to be re-timbered and exploration work carried on. The company proposes to erect a modern mill and flotation-plant.

Superior, December 15.

YAVAPAI COUNTY

(Special Correspondence.)—A rich orebody that is claimed to run 50% zinc, 6% lead, 2% copper, and 2 oz. silver has been opened at the Hillside mine.——A standard drilling-rig is being shipped to the Chino valley for the Arizona Oil & Refining Co.——Sulphide ore carrying 20 to 25% copper has been struck in the drift under the Maintop orebody, which is being driven preparatory to raising to the 1200-ft. level of the Jerome Verde.——Work is to commence within a few days upon the Verde Tunnel & Smelter railroad from the United Verde crushing-plant to Jerome.——A. G. Harbaugh has made an examination of the Verde Apex and Venture Hill Copper properties and, as a result, has taken half of E. L. Bartholomew's option on 100,000 shares of treasury stock. Money to develop these properites will be raised immediately.——A group of 10 claims, called the Old Corkscrew, in Pine Flat, near Goodwin, has been purchased by J. A. Peacock of Fort Worth, Texas. The Circle Park Mining Co. will be formed to operate these claims.——The compressor at the Abe Lincoln Copper Co. is in place; the 190-ft. shaft will be sunk to the 500-ft. level. A larger hoist is also to be erected.——J. R. McEwen and E. C. Evans have taken an option on the Belcher property in the Big Bug district.——The Vesuvius gold mine is being developed by R. B. McMahon, the owner.——The Copper Key property of 20 claims, in Black canyon, has been successfully financed. Sinking of a 500-ft. shaft will commence immediately.——The Big Copper Chief just south of Bumble Bee has also been financed.——New machinery is being erected at the Ada C. molybdenum mine north of Wickenburg, preparatory to sinking the 60-ft. shaft another 300 ft. The ore is wulfenite and is reported as averaging 5½% of MoO_3.——The gravity tramway from the Wildflower mine of the Crown King to the Bradshaw Development Co. mill is completed.——The Grey Eagle mill in the Mayer district will be running as a custom mill shortly.

Prescott, December 24.

YUMA COUNTY

(Special Correspondence.)—A strike of copper ore has been made in the winze on the Mars claim at the Jerome Wendon Copper Co., at a depth of 62 ft. It is claimed there is 4 ft. of 11.5% copper ore. A car of good-grade ore was recently shipped from a parallel vein on the Mescal claim.

Bouse, December 15.

CALIFORNIA

AMADOR COUNTY

(Special Correspondence.)—The Fremont Con. Mining Co., of Drytown, has started to sink its main shaft an additional 200 ft., to the 2900-ft. level. Prospects are excellent on the 2700-ft. level for a continuance of ore in paying quantities at

greater depth. Wales Palmer is the superintendent.——Sinking is in progress at the Old Eureka property, the intention being to put the shaft down 1000 ft. below the 2165-ft. level. From the 1600-ft. level down the new company has enlarged the shaft to conform to three compartments above and good headway is now being made in the new ground. The old crosscuts and drifts, particularly those on the 1200 and 1600-ft. levels, are being cleared and re-timbered. The Frakes and Goodman ranches purchased by the present company since closing the deal with Hetty Green for the mine will later be used for mill-site and tailing impounding area. T. Walter Beam is in charge of operations at this well-equipped property. ——H. DeC. Richards of San Francisco has recently been appointed consulting engineer to the Central Eureka Mining Co., to work in conjunction with the superintendent, Fred Jost. Detailed mapping of the underground workings is being made for the better handling of the ore-reserve. Ore is being extracted from the 3425, 3350, 2700, and 2500-ft. levels and 30 stamps are kept in operation nearly, but not quite, paying expenses. A 1½c. assessment has been levied recently. During Christmas week, boilers, furnaces, and compressors have been repaired.

Sutter Creek, December 29.

NEVADA COUNTY

(Special Correspondence.)—With the 60-stamp Empire mill operating at capacity and 20 stamps dropping at the Pennsylvania mine, the Empire group is recording the heaviest output of its history and producing in excess of $100,000 per month. Splendid ore is said to be coming from the 2500-ft. level of the Pennsylvania and 4600-ft. level of the Empire, with late developments in the deeper workings particularly encouraging. More than 350 men are on the payroll. George W. Starr is general manager.——At a point beneath the footwall of the Allison Ranch lode a new vein has been found on the No. 2 level of the Allison Ranch mine. The discovery was made in the south-west drift by lessees. The shoot averages 10 in. wide, assaying $30 per ton in free-milling ore. Careful prospecting shows the shoot persists to the seventh level, the deepest point to which the water has been lowered. Twenty-five men are working on company account, and several sets of lessees are active. The mill is running two shifts. W. Harvey, the superintendent, is proceeding with unwatering the shaft to the 1700-ft. level.——The Grass Valley Deep Mines Co., composed of Nevada and Colorado people, has taken a bond and option on the Alaska-Ben Franklin group of quartz claims, situated seven miles south-west of Grass Valley. Extensive work is to start immediately with Thomas W. Bosanko as superintendent. Some good ore has been exposed near the surface.——Considerable activity is reported from Moore's Flat, above Nevada City.——At the Gold Canyon developments are proceeding and good ore is exposed. W. H. Griffith is superintendent. A. Fitzgerald, the superintendent, is pushing work at the Fruitvale group. A large vein of profitable ore is reported exposed.

Grass Valley, December 31.

SHASTA COUNTY

(Special Correspondence.)—The Mountain Copper Co. is preparing to erect a large cyanide plant at Minnesota station, midway between the Iron Mountain mine and Keswick. The plans are drawn and material for the building is on the ground. The cyanide plant will be used to save gold and silver from ores that run high in those metals.——Neeley Brothers' chrome mine, 17 miles west of Castella, is making shipments of chrome. Thirty-five mules pack the chrome three miles to the end of the wagon-road, where auto-trucks are loaded for completing the transportation to the railroad.

Redding, December 27.

(Special Correspondence.)—G. C. Taylor has taken a two-year option on the Donkey copper property, near Ingot. The option provides that a royalty of 10% shall be paid on ore running below and 15% on ore above $35 per ton. The property was worked several months by the Mammoth Copper Co., and is stated to contain much ore of shipping grade.——High-grade shipping ore has been uncovered on the 1000-ft. level of the Anchor mine, one of the properties comprising the Bully Hill group near Delamar. The deposit was opened through the Rising Star shaft. Steady shipments are being made to the Kennett smelter, and local stockholders state it is probable that a large flotation unit will be erected next spring, and possibly an electrolytic zinc plant, similar to the one operated near Kennett by the Mammoth Copper Co. All ores of this district carry a heavy proportion of zinc.——Shipments of silicious copper-silver ore are going to Kennett from the Silver King mine, near Redding; the product comes from a dike 70 ft. wide and upward of a mile long. Considerable prospecting has been carried on and preparations are being made for deeper developments. San Francisco and Montana people are chiefly interested. L. E. Parker is manager.——The Gardella Dredging Co. has practically completed No. 2 dredge and expects to build two more in 1918. The holdings are situated on Clear creek, a few miles below Redding; No. 1 dredge has been operating two years at an excellent profit. The owners plan to reclaim much of the dredged area and devote it to agriculture.——J. A. Wilson and associates have arranged for extensive prospecting of dredging ground near Gas Point. The Shasta Dredging Co. has been working profitable territory in the district for several years. The new area is owned by the Drew estate.

Kennett, December 23.

SISKIYOU COUNTY

(Special Correspondence.)—New lessees are re-opening the Rancherie gold mine, one mile and a half from Hornbrook, and adding new machinery. The local power company is erecting a power-line from Henley to supply the mine with electricity.——John Ritz of Etna who has been operating the Advance mine in the Forks of Salmon district has reduced his working force until the spring.——John Traverse of Etna Mills is operating the Mercury American Co.'s mines at the head of Beaver creek.——Much progress is being made with the new equipment erected on the Know Nothing gold mine, near Forks of Salmon, under the management of W. R. Beall. ——The Dewey gold mine, re-opened last summer after ten years idleness, is operating a ten-stamp mill and auxiliary machinery, driven with electric power. Recent development has uncovered a vein ranging from 10 to 20 ft. wide.——The California Bar placer mine, near Croy, owned by the Vina California Bar Co. of Oakland, has resumed operations under the management of H. J. Croy.

Hornbrook, December 27.

TRINITY COUNTY

(Special Correspondence.)—A vein ranging from 10 in. to 3 ft. wide has been discovered by R. H. Bailey on Maple creek, about four miles from Junction City. The ore contains gold and a little platinum. Mr. Bailey states he has traced the vein 3000 ft. and that much rich ore is exposed. Several claims have been located and development begun. Numerous placer mines were formerly working in this district.——Prospecting of dredging territory continues active along the Trinity river and tributary streams, and much new exploratory work has started along the Salmon river and into Siskiyou county. The Pacific Gold Dredging Co., a Guggenheim subsidiary, is reported interested. Several fairly rich deposits have proved unsuitable for dredging because of presence of numerous huge boulders and heavily cemented gravel. The Pacific Dredging Co. attempted to work deposits of this character in Morrison gulch, but was forced to abandon the enterprise and move its dredge to a point near Carrville. Several companies are now trying to devise a satisfactory method for economical working

of the refractory deposits.——The Oakland owners of extensive asbestos deposits near Cinnabar are planning to operate next spring. The mine is provided with a good plant and is connected with Castella, the nearest railroad point, by an excellent road. A large deposit of asbestos is exposed, much of it being of fine quality, according to the management. The indebtedness of the company has been liquidated and the treasury strengthened.——The Testy, La Grange, Hupp, and other hydraulic mines near Weaverville are active, and several small properties near Lewiston, Douglas City, and Junction City have been placed in shape for an active season. The outlook is favorable for a good year. Particular attention is being paid to recovery of platinum, which occurs in small quantities in the gold-bearing gravels. Representatives of the U. S. Geological Survey have recently advised local operators concerning the importance of recovering platinum.

Weaverville, December 30.

COLORADO

SUMMIT COUNTY

At the new molybdenite mining camp of Climax, situated on the South Park line of the Colorado & Southern railway near Fremont's pass, the American Metal Co., of New York, has almost completed a 250-ton concentration mill for the purpose of making a marketable grade of concentrate from the large body of low-grade molybdenite ore held by the company. Since August 1, about 130 men have been employed in the construction of the mill, boarding houses, necessary mining structures, and two aerial tramways, and in doing development. The mill is situated on a spur track from the railroad at an altitude of 11,300 ft. The mine is about a mile farther up the mountain. The deposit of 1% molybdenite ore outcrops about 800 ft. above the mill. The ore for the mill will be dumped into receiving bins at the mine, and from these will be taken by a two-bucket aerial tramway 500 ft. long, to crusher-ore bins at the foot of the hill. After being crushed the ore will be elevated to other ore-bins by a belt-conveyor, from which it will pass over a Leschen tramway 5000 ft. long to the receiving-ore bins of the mill. The ore will be ground in ball-mills and will then be concentrated in Callow and Janney flotation-machines, the concentrate being de-watered on a Portland filter. The mill will have a capacity of 250 tons per 24 hours. The mill and bunkhouses will be steam-heated. It is expected that the plant will be in operation by the end of February. The large body of molybdenite, running from ½ to 16%, promises a steady supply. Recent sales of 60% molybdenite are reported as having been made at $48 per unit.

The committee named by the Colorado legislature last winter, headed by Siewers Fincher of Breckenridge, to make a complete and exhaustive survey of the smelting industry of the State, in order to give the ore-producers information and data upon which they could figure with accuracy, and which would enable them in the future to deal intelligently in making contracts with the smelters, has completed its work. The investigation has been complete and thorough. O. R. Whitaker, a trustee of the Colorado School of Mines, was secured to take charge of the technical work. His report is replete with charts and tables. The law establishing the committee unfortunately did not provide funds sufficient for the publication of enough of these reports to fill the demand, but they will be made to go as far as possible and early applicants probably can be supplied. The Smelter Investigation Committee has offices in the Capitol building, Denver.

TELLER COUNTY

(Special Correspondence.)—Thrift or war savings stamps took the place of gold coins for Christmas donations to employees by mining and leasing companies of this district this year.——The second discovery at the 500-ft. level of the Empire State shaft has been made by the lessee, Yaksey & Co., on the rich Maloney vein. The shoot opened up for 15 ft. to date is making rich screenings. In the core of the Maloney vein a six-inch streak of fluorite and quartz carries large crystals of calaverite and is good for 100 oz. gold per ton.——Shipments have been resumed from the Wild Horse mine of the United Gold Mines Co. on Bull hill. Carl Evans, superintendent, has opened up a strong body of milling ore at the 500-ft. level of the Gleason shaft and is shipping two cars per week to the Golden Cycle Mining & Reduction Co.'s plant at Colorado Springs.——A new and rich discovery has been made on the Shoo Fly, a Stratton estate property on Womack hill, just beyond the eastern boundary of this city, by Simms Allbaugh & Willis, lesees from the Stratton estate. At a point about 70 ft. west of the Hickman discovery and at a depth of about 75 ft. from surface, the lessees are mining between 2 and 3 ft. of quartz carrying rusty gold and making screenings that will ship at close to five ounces gold per ton.——A new lease covering a three-year term has been secured from the Free Coinage Consolidated Co. by L. F. le Brun of Cripple Creek, with whom is associated F. H. Phillips of New York, on 1300 ft. of the Wilson lode. The lessees are driving into the leased ground from the 800-ft. level of the Lee shaft, giving them 400 ft. of virgin ground under the Murphy, Mercer, Reed, and Van Tilborg stopes on the Wilson, from which big money has been made by the different lessees named.

Cripple Creek, December 24.

IDAHO

LATAH COUNTY

The Luelia mica mine, at Avon, has been sold by Arthur A. Booth of Spokane for $30,000 to a syndicate of Seattle, North Dakota, and Minnesota men that has organized the Idaho Mica Co., with capital of $500,000. The officers are John Patterson, president; John A. Soboe, vice-president; H. G. Otis, secretary; and H. S. Yarrow, treasurer. It is said that a quantitiy of mica is exposed in the Luelia adit. Production was begun 20 years ago and a carload shipment was made to San Francisco before the fire.

SHOSHONE COUNTY

The Caledonia Mining Co. of Kellogg will pay $78,150, at the rate of 3c. per share. The Consolidated Interstate-Callahan Co. will pay 50c. per share, one-half its former quarterly rate. The disbursement will total $232,495.——The Douglas Mining Co. will pay ¾c. per share for the first quarter. The payment will amount to $6403.——The Hecla Mining Co. paid 5c. per share, amounting to $50,000, making a total for 1917 of $1,600,000, and a grand total of $6,905,000.

NEVADA

CLARK COUNTY

(Special Correspondence.)—Development of the main orebody on the 700-ft. level of the Yellow Pine is being pushed vigorously. The orebody has been opened for over 200 ft. on its strike and shows shipping ore throughout. The winze from this level has cut, at a depth of 40 ft., an orebody nine feet thick, assaying 48% zinc. From the 900-ft. level crosscutting is advancing to tap the main vein and should attain its objective within three months. The mill is running at full capacity and tailing from the slime pond is being dried and shipped. In the present year dividends totalling $360,000 have been disbursed. There remains in the treasury $100,000 in cash, and $75,000 represented by Liberty bonds.——The Manganese Association has started shipments to Salt Lake, and expects soon to be in a position to produce 200 to 300 tons of ore per day. Numerous ore-buyers are in the district, and several claims adjacent to the producing group have been examined. The property is a few miles from Las Vegas.——The winze from the adit in the Oro Amigo is down 65 ft. and has been in ore for 35 ft. The shoot ranges from 8 to 14 in.

wide and is high grade. Copper, silver, and gold occur in the ore together with a little platinum. Preparations are being made for occasional shipments, and for further development. Sam Yount is manager.——Dedrich Bros. have made a promising discovery on the property of the St. Anthony Mining Co., near Goodsprings. The vein ranges from 12 to 24 in wide and occurs in ferruginous formation. The ore is stated to assay 45% copper in the form of copper glance.

Goodsprings, December 23.

ESMERALDA COUNTY

(Special Correspondence.)—The second payment on the indebtedness of the Florence-Goldfield company has been made to creditors, and Harry B. Clapp, the receiver, expects to make the final payment on or before January 15. Immediately upon recovering control of the property the owners will arrange for re-organization of the company and resumption of work, according to advices received here by stockholders. The Dell Hammond-Charles Taylor lease is developing rich ore and reports net earnings of $15,000 in a brief period. A number of lessees are opreating on Florence ground with good results.——The cyanide and flotation units of the Goldfield Consolidated are treating approximately 32,000 tons per month, divided about equally between mine-ore and tailing from the old mill-pond. In October, 15,975 tons of the latter was retreated, netting $5800. In the same period 15,900 tons of ore yielded net profits of $15,043, making a total earning of $20,843.——Developments on the 1350-ft. level of the Grizzly Bear are claiming interest, with ore ranging from $9.60 to $10.35 per ton coming from two working-faces. The orebody recently discovered in the Aurora Consolidated, at Aurora, is stated to be developing satisfactorily.——The winze from the main drift on the 880-ft. level of the Jumbo Junior has exposed a shoot 18 in. wide, reported to assay $50 to $150 per ton in gold, silver, and copper, with silver predominating. The discovery was made near the hanging wall and prospecting is proceeding to determine extent of the shoot. A shipment is being prepared. Connections have been established between the northern workings and the main south drift of the Kewanas mine.——J. J. Jordan and Edward Yeiser have appealed to the Supreme Court from an order issued by Judge Walsh, restraining them from disposing of their interest in the Life Preserver group of gold claims at Tolicha. They are said to have agreed to sell the property to Zeb Kendall for $120,000. Dave Ward secured the restraining order, claiming he held a one-third interest.

Goldfield, December 22.

MINERAL COUNTY

(Special Correspondence.)—Development on the 250-ft. level of the Nevada Rand, near Rand, has proved encouraging, with the new vein developing well; 20 tons of ore averaging $100 per ton has been shipped, and an 8-in. shoot assaying $1675 in silver and gold has been uncovered. The management is preparing to drive from the 350-ft. in expectation of cutting the vein at this point. A mill is planned, as upward of 35,000 tons of $15 ore has been blocked out.——The Reservation district, a few miles from the station of Reservation on the Goldfield branch of the Southern Pacific railway, is attracting considerable attention, with silver-lead, gold, and copper deposits occurring. The Packsaddle is being placed in shape for production, and sinking of a new shaft at the Reservation Hill will start shortly to open promising ore in new territory and avoid the water which forced suspension of operations in the old workings. The June Bug is active, and the Sebastopol is being placed in shape for steady work. The Mountain View has produced some good ore this year; the mill has been in operation for several months.

Luning, December 29.

(Special Correspondence.)—The Calavada Copper Co. has erected an air-hoist on the 1000-ft. level of the main shaft and will continue sinking the winze, which is now down to the 1100-ft. point, to the water-level; this, it is expected, will be reached in the next 200 ft. It is believed that the primary sulphides will be found at the water-level and also secondary enrichment from the re-deposition of the values that have been leached from the oxidized ores above. High-grade ore has been found from the surface down and at the 1000-ft. level there is ten feet of oxidized ore averaging better than 15% copper, with residual bodies of chalcocite that go 50%. ——The Kirchen Mines Co. is shipping from three ore-shoots in the lower adit of the St. Patrick mine, the third having been opened during the week.——The three new finds which were recently made in the mines of the Pilot Copper Co. are holding their own as development proceeds. The first two were in the Champion mine, at the 150-ft. level, and the third in the big vein of the Anderson mine.——The face of the drift on the electrolytic claim of the Congress Copper Co. is still



PART OF NEVADA AND CALIFORNIA

in ore that averages 5%, while the adit on the Neversweat claim is making good progress and will soon reach the downward extension of the rich orebody that was glory-holed at the surface.

The last two carloads of ore shipped by the Pilot Copper Co. from Luning returned $1132 and $1209, respectively, after deducting freight and treatment charges. Three important finds were made during the week. The first was in the Champion mine in a raise from the 150-ft. level where a hitherto unknown vein carrying 3 to 10% copper was cut. The second was on the same level about 500 ft. distant. In a cross-cut going through the heart of a low-grade orebody a face of carbonate ore 7 ft. wide and 8 ft. high was exposed which averages 4% copper. The third was in the Anderson mine where the hanging wall of a 28-ft. vein was reached. The last 8 ft. of this vein averages better than 4½%.——In an east drift on the Electric claim of the Congress Copper Co. the last 26 ft. has been in ore averaging 5%. On the company's Neversweat claim an adit is being run to get under the old glory-hole from which so much rich ore has been shipped.—— At the Luning Idaho mine, in addition to the usual work, an adit has been started in Erickson gulch which will tap the orebody developed in the Stockham adit at 100 ft. greater depth. It is probable that this can be run in ore the entire distance.——The Kirchen Mines Co. is maintaining steady shipments of high-grade ore from its St. Patrick mine, the

stopes on the lower level are furnishing the bulk of the ore now going out.

Lunins, December 24.

WASHOE COUNTY

(Special Correspondence.)—A new large Cameron station pump has been ordered for the Nixon-Nevada mine, and as soon as it is in place a winze will be started on the No. 1 vein at a point about 100 ft. from the cross-cut. Here is an unusually good showing, with bunches and streaks of almost pure chalcocite in the oxidized ores. Stoping in good ore is in progress on the No. 2 vein, the present workings being about 75 ft. from the cross-cut. It is evident that the mineralization from the No. 4 vein extends much farther into the wall-rock at the lower level than from the other veins. The cross-cut still shows lots of iron and copper stains, but recent surveys show that it will have to be run considerably farther before the vein is reached.——The drift on the No. 1 vein is now out 350 ft. from the cross-cut and a raise is to be put up near the face to explore the new orebody. This is the second ore-shoot that has been found in the north drift, the first being 200 ft. long and the ore high-grade. The north drift on the No. 2 vein is out 100 ft. and is also in high-grade ore. The main cross-cut still shows copper stains and small stringers, but has not yet cut No. 4 vein. The new six-foot vein which was recently opened by surface trenching looks especially good.

Copperfield, December 22.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—The Oaks Co. is working through its new main Central shaft. Levels are being run to connect with the lower working of the Maud S. mine and as soon as these are completed ore will be extracted through this shaft. Development and ore-breaking continues in the Pacific, Maud S., and Eberle mines.——Material is coming in rapidly for the new Socorro Mining & Milling Co.'s plant. Construction work is progressing at mill and mine. It is understood that the mill will have a considerably increased capacity and will be modern in every way.——This has been a big year for the Mogollon district. Tonnage in the various mills has been up to capacity and, while the figures are not yet available, the total production will be large. Development in the lower levels of some of the deepest work in camp has opened up good ore and the mineral discovered within the year and the new mines opened, places the Mogollon district well in the lead of the silver-gold camps of the South-West.

Mogollon, December 26.

OREGON

JACKSON COUNTY

(Special Correspondence.)—Harvey J. Sallee, who recently bonded the Barron gold mine east of Ashland from the Alton Mining Co. of Ashland, has closed down the mine for the winter and left for his Reed mine in Shasta county, California. He has spent $6000 in re-opening the Barron mine, but the late heavy rains have made the roads impassable between the mine and railroad. During the operation five car-loads of ore were shipped to the Mammoth Copper Co. smelter at Kennett, which assayed 1 oz. of gold to 20 oz. of silver, with some zinc and lead. The high-grade ore assayed $75 per ton in gold and silver, while the low-grade $10 to $15. There is 1000 ft. of drift in the mine, one main drift and some prospects. The lessee thinks well of the property, although it presents some difficulty in the way of economical operation Under the conditions this fall the haul to the railroad, a distance of seven miles, cost $5 per ton, while the difficulty of placing a mill at the mine is that water is only available six months in the year. ——Much progress is being made in developing and operating the Chisholm cinnabar mines, 12 miles north of Gold Hill. W. P. Chisholm, the owner, reports that he will put in crushers and concentrating machinery next spring to operate with his 12-pipe furnace.——L. F. McConiche, of Tacoma, representing people of that city, is developing the Buena Vista group of cinnabar mines, recently purchased from W. S. Webb of Medford. This property is just over the Jackson county line in Douglas county, and is an extension of the mercury-bearing dike that extends through Jackson county from California.



PART OF OREGON

The property will be fully equipped with furnaces next spring. ——Extensive work is being done at the Greenback gold mine in the north end of this county. The old equipment is being dismantled in order to erect new machinery during the coming season. The 7000-ft. aerial-tramway has been sold and is being removed to equip the State limestone-fertilizer plant at Gold Hill.——The late rains have set the placer mines through southern Oregon and northern California in operation, and from present indications the coming season will be a successful one. Considerable attention will be given by the operators to save platinum, which formerly went to waste.

Gold Hill, December 27.

WASHINGTON

STEVENS COUNTY

Cross-cuts are proceeding in two directions from the bottom of a 175-ft. shaft in the property of the Silver-Antimony Mining Co., Chewelah. The west cross-cut, which has been driven 100 ft., has penetrated 40 ft. of mineral that is marked with ribbons of ore containing silver and copper, some of it in the native form. The east cross-cut, driven 45 ft., is directed at a body of silver and antimony four feet wide at the surface. The directors of the company are J. J. Wells, president; J. Kuntz, vice-president; and Harry W. Hoefer, secretary-treasurer, Uniontown; J. J. Schoenberg, general manager, Chewelah, and C. W. Schlee, Walla Walla. Harry Dudman is the Spokane representative.

SPOKANE COUNTY

Shipments by the Knob Hill Co. are proceeding at the rate of a carload of ore every third day. The grade is $9.50 per ton, and the production is about paying the expenses. The

source of the ore is a section of the vein 18 to 24 in. wide on the 200-ft. level of the shaft workings. More or less rock becomes mixed with the ore in breaking, which explains the low grade of the product. The drift lacks about 200 ft. of attaining the point where ore of better grade was found on the level above. Operations are being confined chiefly to a raise from the 200-ft. level. A little ore is being broken in a stope started north of the raise. The advance of the raise, which is to be connected with a winze, is handicapped by water. Until the raise is completed and ventilation provided little work can be done on the new level. Fourteen carloads of 50 tons each were shipped to the Tacoma smelter in November.

CANADA

BRITISH COLUMBIA

The strike of men employed by the Consolidated Mining & Smelting Co. at Trail, has been called off, according to a report from Trail received December 20. One thousand men, it is estimated, returned to the plant and the remainder will return as soon as places can be found for them. It is believed the Consolidated company will issue an order for the resumption of operations on its properties at Kimberley, Rossland, Eholt, and elsewhere in British Columbia, which were suspended when the strike was called on November 15. The number of men affected is said to be from 6000 to 7000, including those employed at Trail. The tonnage released is 8000 to 10,000 per week, of which about 10% is from mines of Washington.—— The suspension was not total in mines outside of those owned by the Consolidated. Operations were maintained with reduced forces on several properties. A large tonnage of lead ore has been accumulated, but zinc ore was sold in the United States by several corporations in the interim.

Obituary

FRED TURREL GREENE, mining engineer and geologist, was killed in a motor accident at Butte, Montana, on Christmas day. He was born at Brooklyn, New York, 43 years ago; he graduated from the University of Toronto in 1893 and from the Michigan College of Mines in 1897. Immediately thereafter he entered the engineering department of the Boston & Montana company at Butte, and a few years later he became assistant to Horace V. Winchell, then geologist for the Amalgamated Copper Co., this association with Mr. Winchell continuing to the end, for at the time of the fatal accident he was working with Mr. Winchell as a geological expert in the litigation between the Elm Orlu and Butte & Superior companies. His untimely death was a great shock to the mining community of Butte, where he had been socially prominent and generally liked as a sincere, honest, and thoroughly capable engineer.

JAMES W. MALCOLMSON died suddenly on December 26 at Kansas City, Missouri. He was consulting engineer to the Lucky Tiger Combination Gold Mining Co. at the time of his death and was largely responsible for the success of that enterprise, well known in Mexico as the El Tigre. He was educated at the Royal School of Mines, London, whence he graduated with honors in 1889. During the course of his career, which was honorable and successful, he served as mining engineer to the Consolidated Kansas City Smelting & Refining Co. from 1893 to 1898, as manager of the mining department of the A. S. & R. Co. in Mexico from 1902 to 1909, and since then as consulting engineer to the Lucky Tiger Combination company, with headquarters in Kansas City. He attended the recent meeting of the Institute at St. Louis in October, when he appeared to be in excellent health and spirits. His sudden end will come as a great shock to his many friends, who will join in sympathy for his wife and family.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

W. E. STEPHENS, from Vernon, B. C., is here.

CHARLES BUTTERS has returned from Washington.

HOWLAND BANCROFT is at the Engineers Club, New York.

SCOTT I. WELLMAN, of Los Angeles, is in San Francisco this week.

WALTER G. PERKINS has returned from New York to San Francisco.

THOMAS M. BAINS JR. is Major in the Engineer Officers Reserve Corps.

GEORGE E. FARISH has arrived at New York on his return from Salvador.

SCOTT TURNER is expected in San Francisco from Lima, Peru, within two weeks.

E. E. MCCARTHY is now resident manager for the Yukon Gold Co. at Dawson.

STUART H. INGRAM has returned from Nayarit, Mexico, to perform military service.

VAUGHAN M. LAVERY is Lieutenant in the Third Tunnelling Corps, Canadian Engineers.

O. B. PERRY, Major in the U. S. Engineer Reserve Corps, spent Christmas at Palo Alto.

LIEUTENANT F. J. HOLNIGMANN is now with the 62nd Infantry, Camp Fremont, California.

CHARLES S. HALEY is Captain in the U. S. Engineer Reserve Corps and is now at Camp Lee, Virginia.

C. B. LAKENAN, general manager for the Nevada Consolidated Copper Co., was here during the week.

W. H. HOWARD, metallurgist to the A. S. & R. Co. at Salt Lake City, was in San Francisco on his way to Tacoma.

EDWIN F. GRAY, consulting engineer to the Consolidated Copper Co. of Ely, Nevada, spent the holidays in San Francisco.

A. E. DRUCKER is at Baltimore supervising construction and starting of a concentrating mill for the Baltimore Tube Company.

T. ISHIKAWA, mining engineer to the Kuhara Mining Co., Japan, is visiting the copper mines and smelters of Montana and Arizona.

WILLIAM B. FISHER, who is taking part, as an expert, in mining litigation at Butte, spent the Christmas holidays in San Francisco.

GEORGE B. BUTTERWORTH is returning from New York to Aroa, Venezuela, where he is manager for the South American Copper Syndicate.

J. A. THOMAS, formerly with the Consolidated Arizona Smelting Co. at Humboldt, is with the Cananea Copper Co. at Cananea, Sonora, Mexico.

ROBERT R. VAN VALKENBURGH, formerly with the Alaska Gold Mines Co., has been appointed resident superintendent for the Michigan-Utah Consolidated Mines Company.

C. A. THOMAS has resigned as manager of the Yukon Gold Co. and has been appointed assistant to E. B. BRADEN, the vice-president of the Selby Smelting & Lead Co., at San Francisco.

A. I. M. E. San Francisco

A meeting will be held next Tuesday evening, January 8, at the Engineers Club. W. J. Loring will open a discussion on 'The Economic Value of Gold Mining.' Carl C. Plehn, Professor of Finance, University of California, will continue the discussion, and E. H. Benjamin and F. W. Bradley have promised to participate. Dinner ($1) at 6:30; meeting at 7:30.

THE METAL MARKET



METAL PRICES

San Francisco, December 31

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.95
Antimony, cents per pound	17.00
Antimony (wholesale), cents per pound	15.25
Electrolytic copper, cents per pound	23.50
Pig-lead, cents per pound	6.50— 7.50
Platinum, soft and hard metal, respectively, per ounce	$105— 113
Quicksilver, per flask of 75 lb	115
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	20

ORE PRICES

San Francisco, December 31

Antimony, 45% metal, per unit	$1.00
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.70— 0.85
Magnesite, crude, per ton	$8.00—10.00

Manganese: The Eastern manganese market continues fairly strong with $1 per unit Mn quoted on the basis of 48% material.

Tungsten, 60% WO_3, per unit	26.00

Tungsten ore is firm, all the stock in New York has been exhausted.

Molybdenite, per unit MoS_2	$40.00—45.00

EASTERN METAL MARKET

(By wire from New York)

December 31.—Copper is fairly active at 23.50c. Lead is dull and firm at 6.50c. all week. Zinc is inactive and steady at 7.87c. all week. Platinum is unchanged at $105 for soft metal and $113 for hard.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Dec.	26 — 23.50	Nov.	20 — 23.50
"	27 — 23.50	"	27 — 23.50
"	28 — 23.50	Dec.	4 — 23.50
"	29 — 23.50	"	11 — 23.50
"	30 Sunday	"	18 — 23.50
"	31 — 23.50	"	25 — 23.50
Jan.	1 Holiday	Jan.	1 — 23.50

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	13.60	24.30	29.53	July	19.09	25.66	29.67
Feb.	14.38	26.62	34.57	Aug.	17.27	27.03	27.42
Mch.	14.80	26.65	36.00	Sept.	17.69	28.28	25.11
Apr.	16.64	28.02	33.16	Oct.	17.90	28.50	23.50
May	18.71	29.02	31.69	Nov.	18.88	31.95	23.50
June	19.75	27.47	32.57	Dec.	20.67	32.89	23.50

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Dec.	26 — 6.50	Nov.	20 — 6.50
"	27 — 6.50	"	27 — 6.50
"	28 — 6.50	Dec.	4 — 6.50
"	29 — 6.50	"	11 — 6.50
"	30 Sunday	"	18 — 6.50
"	31 — 6.50	"	25 — 6.46
Jan.	1 Holiday	Jan.	1 — 6.50

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	3.73	5.95	7.64	July	5.59	6.40	10.93
Feb.	3.83	6.23	9.01	Aug.	4.62	6.28	10.75
Mch.	4.04	7.26	10.07	Sept.	4.62	6.86	9.07
Apr.	4.21	7.70	9.38	Oct.	4.62	7.02	6.97
May	4.24	7.38	10.29	Nov.	5.15	7.07	6.38
June	5.75	6.88	11.74	Dec.	5.34	7.55	6.49

The trust quotation for lead remains at 6.25c., though buyers, on account of freight congestion, are prepared to pay above that figure for spot delivery.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Dec.	26 — 86.62	Nov.	20 — 85.62
"	27 — 86.62	"	27 — 84.60
"	28 — 86.12	Dec.	4 — 84.70
"	29 — 86.87	"	11 — 85.70
"	30 Sunday	"	18 — 85.38
"	31 — 86.87	"	25 — 86.42
Jan.	1 Holiday	Jan.	1 — 86.62

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	48.85	56.76	75.14	July	47.52	63.06	78.92
Feb.	48.45	56.74	77.54	Aug.	47.11	66.07	85.40
Mch.	50.61	57.89	74.13	Sept.	48.77	68.51	100.73
Apr.	50.25	64.37	72.51	Oct.	49.40	67.86	87.38
May	49.87	74.27	74.61	Nov.	51.88	71.60	85.97
June	49.03	65.04	76.44	Dec.	55.34	75.70	85.97

Samuel Montagu & Co. says: The negotiations of the British and United States governments with regard to the purchase of a substantial portion of the world's production do not yet appear to have reached a definite form. Items of news have been cabled from New York about the matter, but not of sufficient precision to enable a judgment to be founded as to the effect of this important projected step upon the eastern exchanges and the future of silver. It is stated that the United States of America produced 72,833,000 oz. in 1916, out of a world production of 172,383,000. It is anticipated that the United States will turn out at least 75,000,000 oz. in 1917, so that with improved conditions in Mexico, the world's total may approximate 200,000,000 oz. for this year. Should, therefore, the original information be correct, and an amount of 100,000,000 oz. be acquired by the Governments for delivery in 1918, this would be equal to 50% of the world's probable production, while if only the United States output be purchased, it would be equal to about 37½%. The Department of Commerce in America announced on November 28 that the silver exports during this year had amounted to $62,234,000. There has been a considerable shrinkage, namely, 147 laos in the Indian note circulation. As regards the reserves, the silver holding was reduced by 194 laos, but the gold increased by 47 laos.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Dec.	26 — 7.87	Nov.	20 — 7.98
"	27 — 7.87	"	27 — 8.00
"	28 — 7.87	Dec.	4 — 8.00
"	29 — 7.87	"	11 — 7.91
"	30 Sunday	"	18 — 7.75
"	31 — 7.87	"	25 — 7.75
Jan.	1 Holiday	Jan.	1 — 7.87

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	6.30	18.21	9.75	July	20.54	9.90	8.98
Feb.	9.05	19.99	10.45	Aug.	14.17	9.03	8.58
Mch.	8.40	18.40	10.78	Sept.	14.14	9.18	8.33
Apr.	9.78	18.62	10.20	Oct.	14.05	9.92	8.32
May	17.03	16.01	9.41	Nov.	17.20	11.81	7.76
June	22.20	12.85	9.63	Dec.	16.75	11.26	7.84

The New Jersey Zinc Co. was the successful bidder for the contract to supply the Navy department with 2,000,000 lb. of prime Western spelter, agreeing to supply the metal at 7⅞c. on any basis.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending

Date			
Dec.	4 — 115.00	Dec.	18 — 115.00
"	11 — 115.00	"	25 — 115.00
		Jan.	1 — 130.00

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	51.90	222.00	81.00	July	95.00	81.20	102.00
Feb.	60.00	295.00	126.25	Aug.	93.75	74.50	115.00
Mch.	78.00	219.00	113.75	Sept.	91.00	75.00	112.00
Apr.	77.50	141.60	114.50	Oct.	92.90	78.20	102.00
May	75.00	90.00	104.00	Nov.	101.50	79.50	102.50
June	90.00	74.70	85.50	Dec.	123.00	80.00	.....

The spot position for quicksilver is as bad as ever and little spot material is to be had. While Californian virgin quicksilver is offered at $115 for shipment from California, the arrivals are slow and such lots as actually reach New York demand a good premium. The last business reported has been done at $119 spot New York.

TIN

Prices in New York, in cents per pound.

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	34.40	41.76	44.10	July	37.38	38.37	62.60
Feb.	37.23	42.60	51.47	Aug.	34.37	38.88	62.53
Mch.	48.76	50.50	54.27	Sept.	33.12	36.66	61.54
Apr.	48.25	51.49	55.63	Oct.	33.00	41.10	62.24
May	39.28	49.10	63.21	Nov.	39.50	44.12	74.18
June	40.26	42.07	61.93	Dec.	38.71	42.55	85.00

Tin prices have actually reached 90c. per pound, quoted for spot Straits tin, but with the metal market closed from December 21 to 26 the position might undergo some change and prices can only be given nominally.

Charles Hardy says: On account of a large foreign inquiry coming in at the same time as one of our largest users at home appeared in the market, the tungsten market has been exceedingly firm during the past week and most good-grade ore in New York found ready buyers, even material on steamers shortly due was readily absorbed by the market. The tungsten price remained steady at a slight advance and $24.50 was paid for high-grade wolframite with prices ranging lower for off-grade ore. Such scheelite as was offered was readily sold at $26 per unit. The year closes with a firm market with a good demand and the prospects for the new year of prices continues at least on the present level if not higher.

Again an active business has been done for such molybdenum as can be delivered immediately. The demand is quite good and prices range from $2.25 to $2.30, according to grade.

The shipping conditions interfere largely with the regular arrivals of manganese ores and such small lots as reach New York market from time to time readily find buyers at a premium over the schedule price, which still remains at $1 20, delivered at furnace, for the 48% ore.

Eastern Metal Market

New York, December 26.

The year draws to a close with all the markets inactive and with two important metals under strict Government control, namely copper and tin, and also with the prospect that lead and zinc will pass under similar regulation when the conditions warrant. In 1917 copper, tin, and lead reached higher levels than at any time during the War, but, as the year ends, all the metals are lower than in many months, with the exception of tin which now stands at the highest level in its history.

Today copper is unchanged, but moving freely at regulated prices.

Tin is still scarce and nominal.

Lead is firm, but inactive.

Zinc is a little stronger, but quiet.

Antimony is lifeless and unchanged.

In the steel market the year ends with practically an assured prospect that there will be no important changes in present fixed prices, at least during the first quarter. A proclamation by the President is expected daily which may extend the operation of the present schedule. Stocks of pig-iron have been so depleted for steel-making purposes that, as these are nearly gone, there has resulted a scramble for iron that would have sent prices sky-high but for Government regulation. The prospects are that there will have been a material increase in both pig-iron and steel production in 1917 over 1916, and the latter was a record year.

COPPER

There seems to be no reason for believing that there will be any change in the price of copper for at least three months. Continuance of the present prices is practically assured so far as steel is concerned, and it is inferred as to copper. With the market controlled absolutely as to price, sales, and distribution, and with everything subservient to war-needs, there is no chance for excitement in the market nor for any activity as in normal times. There seem to be ample supplies for most purposes, the only impediment being delays in shipments because of railroad congestion and storms. Sales are being made for first-quarter delivery of all grades of copper at 23.50c. per lb. in the larger market, and at 24.67½c. in the jobbing realms. Metal is being released for commercial as well as for war-needs, where possible, and satisfaction seems to prevail generally.

TIN

The utmost confusion and delay in the matter of import licenses continues. Some importers are in serious straights, and are decidedly discouraged. In more than one case, because of delays in the mails or for other reasons, licenses from Washington have been late in reaching New York, so that no further extensions in general orders were possible and the metal went into general stores. This has resulted, despite the utmost efforts to secure information even by cable as to incoming metal, and to comply with Government requirements as fully as possible. Tin actually has been piling up on the docks, for it cannot be accepted through the custom house until the importer obtains his license. Because of these conditions, importers are burdened also with additional expenses, and there are no prospects of transferring these to the buyer. The scarcity of all grades continues unrelieved, and the market as a whole is quiet and uninteresting. Sales of all grades for all positions have probably averaged only 50 tons per day for the last week. These have been mostly prompt shipment from England and far futures. Spot Straits is again nominal at 85 to 86c. per lb., New York, with none offered. Some quote even a higher nominal level. Arrivals to December 21, inclusive, have been 1225 tons, with 4400 tons reported afloat. An advance of £4 10s. per ton has been recorded in the London market for spot Straits. The quotation on December 21 was £309 10s., as compared with £305 on December 19, these being the latest cables published.

LEAD

The moderate easiness referred to a week ago in the lead market, resulting in a slight recession in prices, with sales at 6.40c., New York, has disappeared. The market is now firmer at the old level of 6.50c., New York, or 6.35c., St. Louis, for early delivery. This is not explained as due to a more active demand, but as induced by an unwillingness of sellers to part with metal not under contract, since they are apparently well booked with orders. The American Smelting & Refining Co. still quotes 6.25c. per lb., New York. The congestion on the railroads is a decidedly disturbing factor in both lead and zinc and no relief is apparent. Early last week considerable export business is reported as put through, and there are negotiations on foot for more.

ZINC

The market is a little stronger than a week ago, with prime Western for early delivery quoted today at 7.75c., St. Louis, or 8c., New York, but with no sales at these levels to establish this price. The better tone is attributable to the announcement of the bids on 1000 tons of grade C zinc for the Government, referred to last week. These were higher than expected, and ranged from 7.87½c., New York, to 8.60c., New York, with the New Jersey Zinc Co. as the low bidder. Grade C is only slightly better in quality than prime Western. On Saturday, December 22, bids were also taken on 4000 tons of the same grade for the Army, but these had not been made public at this writing. This disclosure is awaited with interest. In general the market is quiet, with few sales in any quarter reported, and not much inquiry. Future deliveries are quoted at ⅛ to ¼c. higher than the levels for nearby metal.

ANTIMONY

Chinese and Japanese grades are unchanged at 15c. per lb., New York, duty paid, for spot or early delivery. The market continues dull and uninteresting.

ALUMINUM

The market is without interest at 36 to 38c. per lb. for No. 1 virgin metal, 98 to 99% pure, for early delivery.

ORES

Tungsten: The market is regarded as a little firmer, with slightly higher prices paid for wolframite, the better grades bringing $24.50 per unit in 60% concentrates. Scheelite has again sold for $26 per unit. A good demand from a large domestic consumer, combined with large foreign inquiry, has contributed the better tone to the market.

Molybdenum and antimony: At prices varying from $2.25 to $2.30 per lb. of MoS_2 in 90% material active transactions are reported the past week. Antimony ores are nominal at $1.75 per pound.

Manganese ores: For domestic ores a leading Eastern dealer quotes as follows: $1.20 per unit for ore containing 50% or more of manganese; $1.10 per unit for ore averaging 46 to 49.99%; $1 per unit for 42 to 45.99% ore; and 90c. per unit for 38 to 41.99% ore. For all these grades maximum limits of 10% silica, 0.20% phosphorus, and 3% iron are stipulated. For Brazilian ore $1.10 to $1.20 per unit is quoted, and as high as $1.30 per unit has been paid for Indian ore.



INFORMATION FURNISHED BY MANUFACTURERS

CALCULATING MACHINES FOR ENGINEERS

By R. M. FARMER

For many years adding or calculating machines have been used in the offices of mining or smelting companies for ordinary routine work. It has long been recognized that they offer far more dependable accuracy and speed than the fastest human calculator could give, but, until recently, these machines did not find favor among men responsible for the technical details of operation for the reason that they were not sufficiently flexible in scope to include all the intricate calculations which occur in the work of mining and metallurgical engineers. Technical men were on the alert for a machine that would meet their requirements, for they realized that mechanical accuracy and speed are to be preferred to the fastest calculator, with his human tendency for error, or to the most adept user of a slide-rule. When such a machine was finally perfected it met with almost instant approval, and has since shown remarkable saving in time and in the intangible but very real losses occasioned through some slight error made when the brain was tired or when a guess between the graduations of a slide-rule was a thirty-second of an inch out of the way.

The appliance which has thus met the demands of technical men is the 'Monroe calculating-adding machine.' First used as an experiment, it has now become part of the standard equipment of the engineers and operators of such concerns as the Utah Copper, Braden, Chino, Ray Con., Phelps-Dodge, American Smelting & Refining, St. Johns, Cerro de Pasco, and many others.



THE MONROE CALCULATOR

The uses for the Monroe machine are legion, as the machine adds, subtracts, multiplies, and divides, with positive action and without the disadvantage common to other similar devices and to the slide-rule of having to carry some governing factor in the operator's mind, such as proper placing of the decimal-point or the number of times a multiplier or divisor has been used.

The American Smelting & Refining Co. uses a Monroe at its Perth Amboy plant, among other purposes for keeping its stock-book of ore on the dump and for compiling its records of assay and laboratory results. In computing this class of figures, or in estimating ore-reserves at a mine, an appreciable amount of time is saved with a Monroe calculator, to say nothing of the assurance that the accuracy is positive. The following example illustrates this fact.

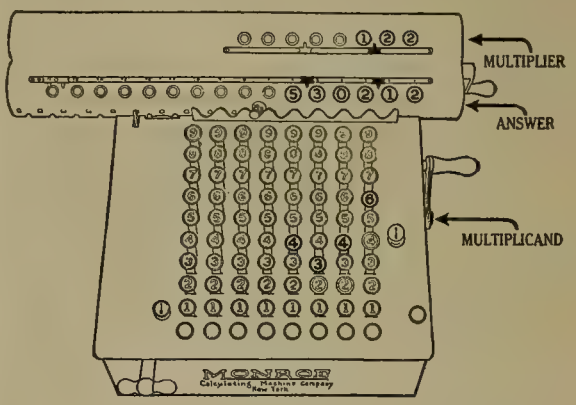


DIAGRAM SHOWING OPERATION OF MONROE CALCULATOR

Problem: to determine the number of ounces per ton in a vein of ore:

Width, ft.	Assay, oz.	Foot-ounces
7	1.22	8.54
4	0.54	2.16
12	1.20	14.40
8	2.20	17.60
5.3	27.40	145.22
7	1.60	11.20
3.5	0.95	3.32
6	0.39	2.34
6	trace	....
7.2	trace	....
66		204.78

$$\frac{204.78}{66} = 3.1 \text{ oz. per ton}$$

This was computed on the Monroe in 37 seconds.

Every technical man knows the amount of time that is wasted in checking up long additions or in repeatedly going over calculations involving decimals carried to the sixth place. Such work is performed on the Monroe machine at remarkable speed. Take, for instance, a case in point:

Problem: to determine an arithmetical mean gross-value for three-quarters of a year:

	3rd quarter	2nd quarter	1st quarter	Total
Tons milled.....	523,871	642,683	541,093	1,707,647
Gross value	$1.01	$1.112	$1.207	$1.111

Method:

$$\frac{(523{,}871\times1.01)+(642{,}683\times1.112)+(541{,}093\times1.207)}{1{,}707{,}647}=\$1.111$$

The time taken on the Monroe calculator was 17 seconds.

It has been shown that the operating speed of a Monroe calculating machine is greatly less than that obtained by other methods, but that the chance for inaccuracy has been brought to an irreducible minimum as well. When a problem is worked, the answer appears at the top of the machine, while at its side is shown a mechanical check on this answer. In multiplication, for instance, the multiplicand remains on the key-board, the answer appears on the lower dial, while on the upper dial is shown the multiplier (Fig. 2). Thus, no doubt is left in the operator's mind as to the accuracy of his calculation.

Simplicity of operation is a feature of the Monroe. To add or to multiply, the crank is turned in one direction, to subtract or to divide, it is turned in the opposite direction. Anyone who can push a button and turn a crank can use the Monroe. It has been found that the average man, unfamiliar with the machine, can attain fair speed in one week. At the present time, the Monroe is being used in the work of mining and metallurgy for estimating ore-reserves, surveying problems, calculation of assay and laboratory results, office routine, structural engineering problems, and cost-accounting in the office and in the operating plant. It should be borne in mind that the calculating machine finds its greatest usefulness on involved problems, and in rushing through work in a limited amount of time. As one mining engineer remarked, "we had to do two weeks work in three days and the Monroe seemed to be the only way out." When you have calculations as long as your arm, and as intricate as a mine-model, it is well to bring mechanical accuracy to your assistance. When one has been working night after night to late hours, the brain is certain to tire. Then it is that the human tendency for error is most liable to crop out, but even in such times of rush and worry, the *Deus ex machina* is infallible. It is well to let him shoulder the petty details of figuring and checking, and to save your brain for constructive thinking.

The calculating-adding machine used by all of the aforementioned mining and smelting companies is made by the Monroe Calculating Machine Co., Woolworth building, New York. Any request for detailed information should be addressed directly to them.

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The LEFAX CORPORATION has just printed, and is distributing to subscribers, catalogue sheets in Lefax loose-leaf form for the following firms: SKF Ball Bearing Co., Hartford, Connecticut, ball bearings, hangers, and fall-blocks; Electric Weighing Co., New York, automatic belt-conveyor scales; Atlantic Terra Cotta Co., New York, fire-brick. Each of these sheets is punched and indexed for filing in the Lefax data-books.

The AMERICIN SMELTING & REFINING Co. has just issued the December number of its 'Safety Review,' this being devoted to what is appropriately called 'Our Service Flag.' It presents a complete list of all the employees of the A. S. & R. that have joined the colors, with mines, smelters, and other departments from which they have been drawn. The honor roll includes 1147 names. An interesting feature of the list is that the civil occupations of the men are also given. We note a goodly sprinkling of lieutenants, corporals, and sergeants, and one captain, this distinction falling to a chemist, Taylor Belcher, from the Omaha plant. The bulletin very happily explains the publication of this list of soldiers in 'Safety Review' by saying, "We are at war as a safety measure, to make the world a safe place to live in and to save political freedom to all men."

COCHISE ROCK-HAMMER

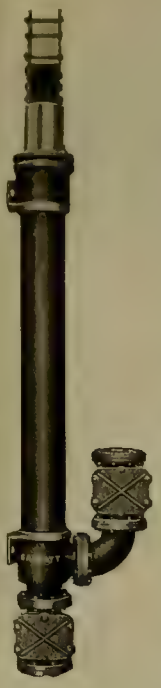
The Cochise Machine Co. of Los Angeles, California, manufacturer of the 'Cochise Rock-Hammer,' will move to its new building in South Los Angeles during the month of January. A well-equipped modern plant has been built to take care of the increased demand for the Cochise products. The rock-hammer shown in the accompanying cut is a drill



THE COCHISE ROCK-HAMMER

for sinking, driving, block-holing, plugging, stoping, and raising. It is furnished with attachments so that it can be used either dry or wet. It is fitted with an automatic oiling device and automatic rotation of a design that has proved most successful. The quick and efficient Cochise valve-mechanism is used in this drill. It possesses an exceptionally quick movement, and enables the hammer to strike fast and hard blows. This valve cuts off early, which allows the air to expand in the cylinder, thus saving power. Both valve and chest are made of steel, hardened and ground, and practically indestructible. A bulletin on the subject of the Cochise rock-hammer will be furnished upon request.

GARRATT JACK HEAD PLUNGER PUMPS



Are Not Affected by

Muddy, Gritty Water

The cylinder has large clearance and the plunger is outside packed at the top. The suction and discharge valves are fitted with bronze taper seats and are easily exchanged by removing bonnets. The Jack Head works altogether on the down stroke; the pump rod is made to weigh just half the amount of pressure exerted on the plunger so that the load is equal and uniform at all times whether on down or up stroke. In this way

Balance Bob is Eliminated

thereby increasing the efficiency and materially reducing cost of installation. These pumps are made with capacities of from 30 to 500 gallons per minute and for elevations up to 600 feet.

W. T. GARRATT & CO.
Established 1850
299 Fremont St. San Francisco, Cal.

THE STANDARD BALL MILL



A Grinding Machine of Proven Efficiency and Capacity
An Economical Mill to Install and Operate

BALL MILLS, the modern crushing device, take the ore from the crusher to desired size in one operation.

A special feature in THE STANDARD BALL MILL is the self-locking corrugated lining, requires no bolts through shell, will wear thinner and longer than those which are bolted in. No special lifting devices required.

Made in all sizes. Following sizes carried in stock for immediate shipment.

5x4, capacity crusher product to 12 mesh, 10 tons per hour; H.P. required 40.

4x3, capacity crusher product to 12 mesh, 3 tons per hour; H.P. required 15.

Laboratory or Sample Mill, either ball or pebble mill, 150 lbs. per charge.

We also carry in stock for immediate shipment Manganese Steel Balls in sizes 1" to 4" and High Carbon Steel Forged Balls.

The Morse Bros. Machinery & Supply Co.
Denver, Colorado



TRAYLOR

Copper Convertors
at the Granby, Anyox, plant

First cost does not interest you. It's the cost per ton output that counts.

In this respect Traylor Convertors are unequalled. Their design is so in line with the best practice, their construction is so carefully thought out and accomplished, that operation is invariably most efficient and final costs are at bed-rock.

The Traylor Convertors shown above are in operation at the Anyox plant of the Granby Con. M. S. & P. Co. They embody every latest improvement in convertor design. They are thoroughly efficient and easy of operation.

Correspondence is invited concerning Traylor Convertors and your work.

Traylor Engineering & Manufacturing Company

Main Office and Works: ALLENTOWN, PA.

New York Office: 36 Church St.
Chicago Office: 1414 Fisher Bldg.
Western Office: Salt Lake City, Utah

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The AMERICIN SMELTING & REFINING Co. has just issued the December number of its 'Safety Review,' this being devoted to what is appropriately called 'Our Service Flag.' It presents a complete list of all the employees of the A. S. & R. that have joined the colors, with mines, smelters, and other departments from which they have been drawn. The honor roll includes 1147 names. An interesting feature of the list is that the civil occupations of the men are also given. We note a goodly sprinkling of lieutenants, corporals, and sergeants, and one captain, this distinction falling to a chemist, Taylor Belcher, from the Omaha plant. The bulletin very happily explains the publication of this list of soldiers in 'Safety Review' by saying, "We are at war as a safety measure, to make the world a safe place to live in and to save political freedom to all men."

COCHISE ROCK-HAMMER

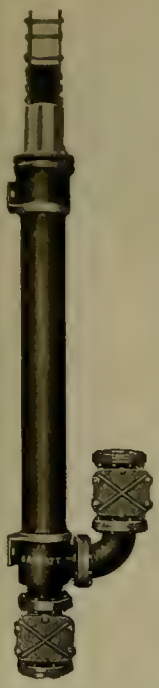
The Cochise Machine Co. of Los Angeles, California, manufacturer of the 'Cochise Rock-Hammer,' will move to its new building in South Los Angeles during the month of January. A well-equipped modern plant has been built to take care of the increased demand for the Cochise products. The rock-hammer shown in the accompanying cut is a drill



THE COCHISE ROCK-HAMMER

for sinking, driving, block-holing, plugging, stoping, and raising. It is furnished with attachments so that it can be used either dry or wet. It is fitted with an automatic oiling device and automatic rotation of a design that has proved most successful. The quick and efficient Cochise valve-mechanism is used in this drill. It possesses an exceptionally quick movement, and enables the hammer to strike fast and hard blows. This valve cuts off early, which allows the air to expand in the cylinder, thus saving power. Both valve and chest are made of steel, hardened and ground, and practically indestructible. A bulletin on the subject of the Cochise rock-hammer will be furnished upon request.

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The cylinder has large clearance and the plunger is outside packed at the top. The suction and discharge valves are fitted with bronze taper seats and are easily exchanged by removing bonnets. The Jack Head works altogether on the down stroke; the pump rod is made to weigh just half the amount of pressure exerted on the plunger so that the load is equal and uniform at all times whether on down or up stroke. In this way

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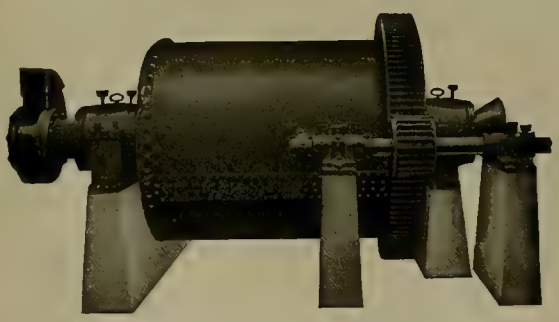
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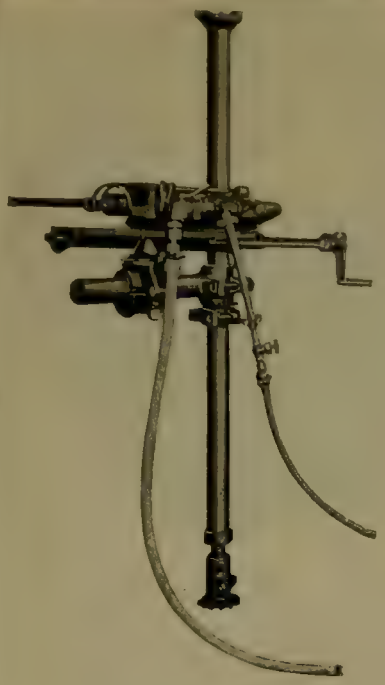
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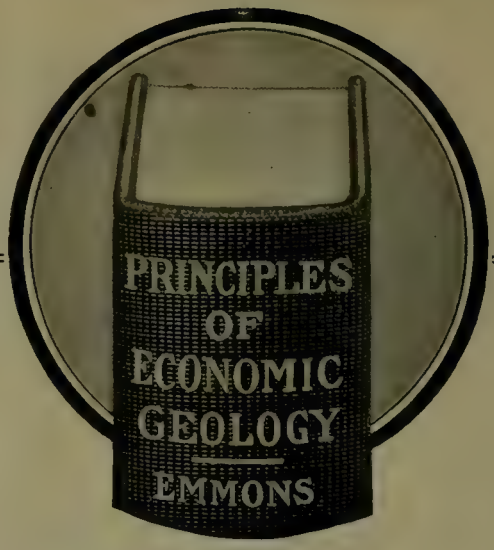
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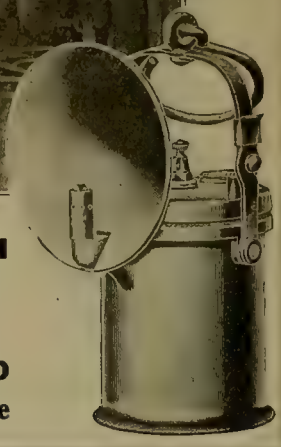
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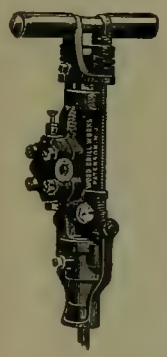


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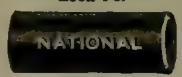
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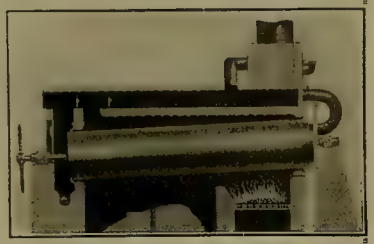
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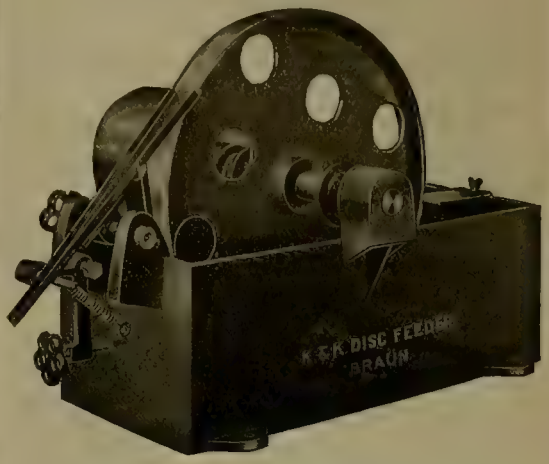
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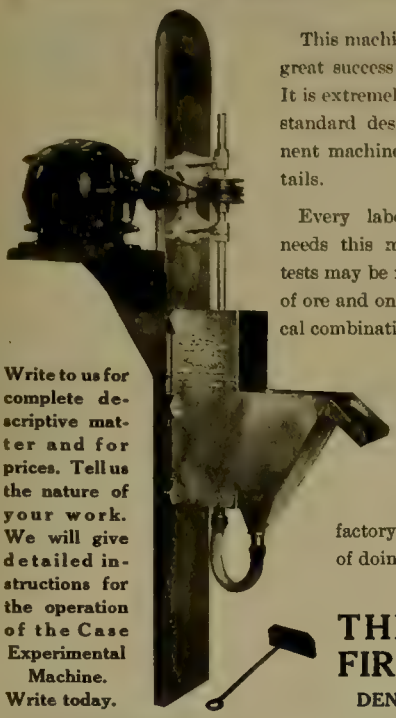
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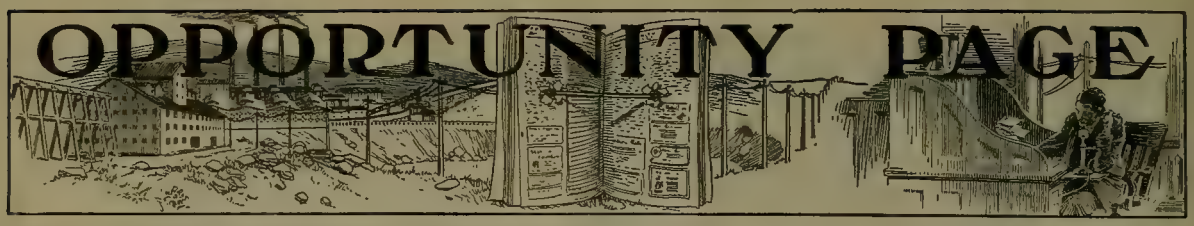
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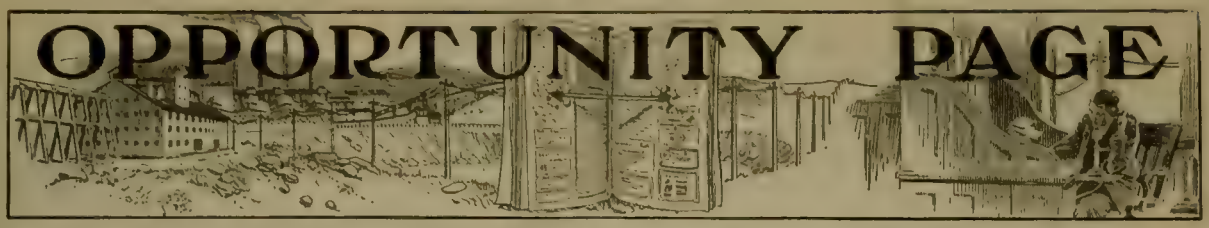
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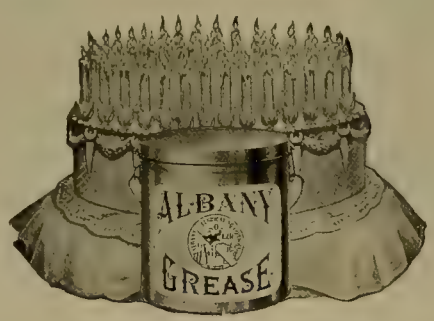
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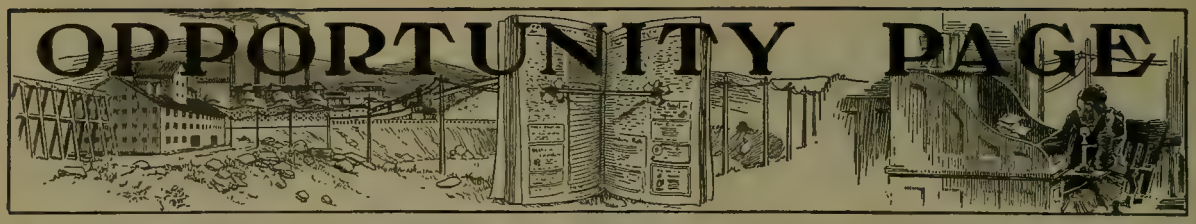
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GENERAL OFFICES.....1081 Fisher Bldg., Chicago
EASTERN OFFICES.....52 Vanderbilt Ave., N. Y.
Branches Everywhere A-1

THE BUYER'S GUIDE

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Chicago Pneumatic Tool Co.
Denver Rock Drill Mfg. Co.
Galigher Machy. Co.
Harron, Rickard & McCone
International High Speed Steel Co.
Reardon, P. H.
Rix Compressed Air & Drill Co.

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Cochise Machinery Co.
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Galigher Machy. Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
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Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Reardon, P. H.
Rix Compressed Air & Drill Co.
Sullivan Machinery Co.
Wood Drill Works

Drills, Core
Harron, Rickard & McCone
Ingersoll-Rand Co.
Sullivan Machinery Co.
Union Construction Co.

Drills, Diamond
Harron, Rickard & McCone
Ingersoll-Rand Co.
Sullivan Machinery Co.

Dryers
Colorado Iron Works Co.
Harron, Rickard & McCone
Ingersoll-Rand Co.
New York Engineering Co.
Sullivan Machinery Co.
Union Construction Co.

Dumps Pneumatic Rotary
Wood Equipment Co.

Employment Bureau
Business Men's Clearing House
Interstate Service Systems
Pacific Audit & System Co., Inc.

Engineering Appliances
Lunkenheimer Co., The

Engineers
(See Professional Directory)

Engines, Internal Combustion
Allis-Chalmers Mfg. Co.
Angels Iron Works
Chicago Pneumatic Tool Co.
Doak Gas Engine Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co
Hendy Iron Works, Joshua
Ingersoll-Rand Co
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co
Reardon, P. H.
Rix Compressed Air & Drill Co.
Tay, George H.
Western Machinery Co
Worthington Pump & Mach. Corp

Engines, Steam
Allis-Chalmers Mfg. Co.
Galigher Machy Co
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Morse Bros. Machy. & Supply Co
Nordberg Mfg. Co.
Traylor Eng. & Mfg. Co.

Explosives
Du Pont Powder Co.
Galigher Machy. Co.
Hercules Powder Co.

Fans, Ventilating
Galigher Machy. Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co
Hendy Iron Works, Joshua
Sullivan Machinery Co.

Filters
Angels Iron Works
Braun Corporation, The
Braun-Knecht-Heimann Co.
Chalmers & Williams
Colorado Iron Works Co.
Galigher Machy. Co.
Koering Cyaniding Process Co.
Morse Bros. Machy. & Supply Co
Oliver Filter Co
Traylor Eng. & Mfg. Co.
United Filters Corporation

Filter Presses
Braun Corporation, The
Braun-Knecht-Heimann Co.
Buttress & McClellan
Galigher Machy. Co.
Harron, Rickard & McCone
Koering Cyaniding Process Co
Morse Bros. Machy. & Supply Co
Traylor Eng. & Mfg. Co.
United Filters Corp.
Worthington Pump & Mach. Corp

Fire Extinguishers
Bullard, E. D.
Justrite Mfg. Co.

Fire-Resisting Coatings
Paraffine Paint Co.

First Aid Equipment
Bullard, E. D.

Flotation Apparatus
Callow, J. M.
Denver Fire Clay Co.
Galigher Machy Co.
Southwestern Engineering Co.

Forges
Buttress & McClellan
Galigher Machy. Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Ingersoll-Rand Co.
Mine & Smelter Supply Co.
Sullivan Machinery Co.

Frogs and Switches
(See "Railway Supplies")

Furnaces, Assay
(See "Assayers' and Chemists' Supplies")

Furnaces, Roasting and Smelting
Allis-Chalmers Mfg. Co.
Colorado Iron Works Co
Denver Fire Clay Co.
Dwight & Lloyd Sintering Co., Inc.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Supply Co.
Mine & Smelter Supply Co.
Pacific Foundry Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Galvanized Sheets
American Sheet & Tin Plate Co.

Gaskets
(See "Packing")

Gasoline Locomotives
Fate Co., The J. D.

Gears
Dodge Sales & Eng. Co.
General Electric Co.
Hendy Iron Works, Joshua
Meese & Gottfried Co.
Western Machinery Co.

Generators
Allis-Chalmers Mfg. Co.
Buttress & McClellan
General Electric Co.
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Supply Co.
Westinghouse Elec. & Mfg. Co.

Giants, Hydraulic
(See "Hydraulic Mining Mach.")

Graphite Products
Dixon Crucible Co., Joseph

Grease, Lubricating
Albany Lubricating Co.
Galigher Machy. Co.

Heaters, Feed Water
Allis-Chalmers Mfg. Co.
Galigher Machy. Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Worthington Pump & Mach. Corp.

Hoists, Electric
Allis-Chalmers Mfg. Co
Angels Iron Works
Bartlett & Snow Co., C. O.
Buttress & McClellan
English Iron Works Co., The
Galigher Machy. Co.
General Electric Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Hendy Iron Works, Joshua
Lidgerwood Mfg. Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.
Sullivan Machinery Co.
Traylor Eng. & Mfg. Co.
Wellman-Seaver-Morgan Co.
Westinghouse Elec. & Mfg. Co.
Worthington Pump & Mach. Corp.

Hoists, Oil and Distillate
Buttress & McClellan
Doak Gas Engine Co.
English Iron Works Co., The
Galigher Machy. Co.
Western Machinery Co.

Hoists, Steam or Air
Allis-Chalmers Mfg. Co.
Bartlett & Snow Co., C. O.
Chicago Pneumatic Tool Co.
Galigher Machy. Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Hendy Iron Works, Joshua
Lidgerwood Mfg. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.
Sullivan Machinery Co.
Wellman-Seaver-Morgan Co.
Worthington Pump & Mach. Corp.

Hose
Angels Iron Works
Chicago Pneumatic Tool Co.
Denver Rock Drill Mfg. Co.
Galigher Machy. Co.
General Electric Co.
Harron, Rickard & McCone
Ingersoll-Rand Co.
Peerless Rubber Co.
Rix Compressed Air & Drill Co.
Tay, George H.

Hose, Air
Bemis Bro. Bag Co.
Buttress & McClellan
Cochise Machinery Co.
Peerless Rubber Co.

Hose Couplings
Angels Iron Works
Chicago Pneumatic Tool Co.
Galigher Machy. Co.
Harron, Rickard & McCone
Ingersoll-Rand Co.
Peerless Rubber Co.
Powell Co., Wm.
Rix Compressed Air & Drill Co.
Tay, George H.
Wood Drill Works

Hydraulic Mining Machinery
Allis-Chalmers Mfg. Co.
American Spiral Pipe Works
Angels Iron Works
Harron, Rickard & McCone
Hendy Iron Works, Joshua
New York Engineering Co.
Sacramento Pipe Works
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Injectors
Galigher Machy. Co.
Harron, Rickard & McCone
Lunkenheimer Co., The
Morse Bros. Machy. & Supply Co.
Powell Co., Wm.
Tay, George H.

Iron Cements
Smooth-On Mfg. Co.

Jigs
Allis-Chalmers Mfg. Co.
Buttress & McClellan
Chalmers & Williams
Colorado Iron Works Co.
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Morse Bros. Machy. & Supply Co.
Stearns-Roger Mfg. Co.
Traylor Eng. & Mfg. Co.
Union Construction Co.
Worthington Pump & Mach. Corp.

Laboratory Supplies
(See "Assayers' and Chemists' Supplies")

Lamps, Arc and Incandescent
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Lamps, Miners'
Braun Corporation, The
Braun-Knecht-Heimann Co.
Bullard, E. D.
Harron, Rickard & McCone
Justrite Mfg. Co

Lead Joint Pipe
National Tube Co.
Tay, George H

Lining for Ball-Mills
Hardinge Conical Mill Co.

Linoleum
Paraffine Paint Co.

Locomotive, Electric
Atlas Car & Mfg. Co.
General Electric Co.
Harron, Rickard & McCone
Morse Bros. Machy. & Supply Co.
Westinghouse Elec & Mfg. Co.

Locomotives, Compressed Air
Porter, H. K., Co.

Locomotives, Fireless
Porter, H. K., Co.

Locomotives, Gasoline
Fate Co., The J. D

Locomotives, Steam
Harron, Rickard & McCone
Morse Bros. Machy. & Supply Co.
Porter, H. K., Co.

Lubricants
Albany Lubricating Co.
Dixon Crucible Co., Joseph
Galigher Machy. Co.
Harron, Rickard & McCone

Lubricators
Albany Lubricating Co.
Galigher Machy. Co.
Harron, Rickard & McCone
Lunkenheimer Co., The
Powell Co., Wm.
Tay, George H.

Machinery, Used
Buttress & McClellan
Morse Bros. Machy. & Supply Co.
Southwestern Wrecking Co.

Manganese
Hardy, Charles

Magnesite
Atkins, Kroll & Co.
Braun-Knecht-Heimann Co.
Hardy, Charles

Metal Buyers and Dealers
American Metal Co.
American Zinc, Lead & Smelt. Co.
Atkins, Kroll & Co.
Beer, Sondheimer & Co.
Empire Zinc Co.
Hardy, Charles
International Smelting Co.
Selby Smelting & Lead Co.
U. S. Smelt., Refining & Min. Co
Vogelstein & Co., L.
Wildberg Bros.

Mills—Ball, Pebble and Tube
Allis-Chalmers Mfg. Co.
Angels Iron Works
Chalmers & Williams
Colorado Iron Works Co.
Hardinge Conical Mill Co.
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Johnson Engineering Works
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp

Mills, Chilean
Allis-Chalmers Mfg. Co.
Chalmers & Williams
Colorado Iron Works Co.
Denver Quartz Mill & Crusher Co
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Morse Bros. Machy. & Supply Co
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp

Motor Trucks
Duplex Truck Co.
White Company, The

Motors
Allis-Chalmers Mfg. Co.
Buttress & McClellan
Chalmers & Williams
Galigher Machy. Co.
General Electric Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co
Westinghouse Elec. & Mfg. Co.

Oil and Grease Cups
(See "Lubricators")

Oil, Flotation
General Naval Stores Co.
Hunter-Johnson Co.
Pensacola Tar & Turpentine Co.
Standard Oil Co., Cal.

Ore Bags
Bemis Bro. Bag Co.
Galigher Machy. Co.

Ore Buyers
(See "Metal Buyers and Dealers")

Oxy-Acetylene Welding and Cutting Apparatus
Bullard, E. D.
Galigher Machy. Co.
Vulcan Process Co.

Oxygen Apparatus
Bullard, E. D.

Oxygen and Hydrogen Generators
Vulcan Process Co.

Packing
Galigher Machy. Co.
Peerless Rubber Co.
Smooth-On Mfg. Co.
Tay, George H.

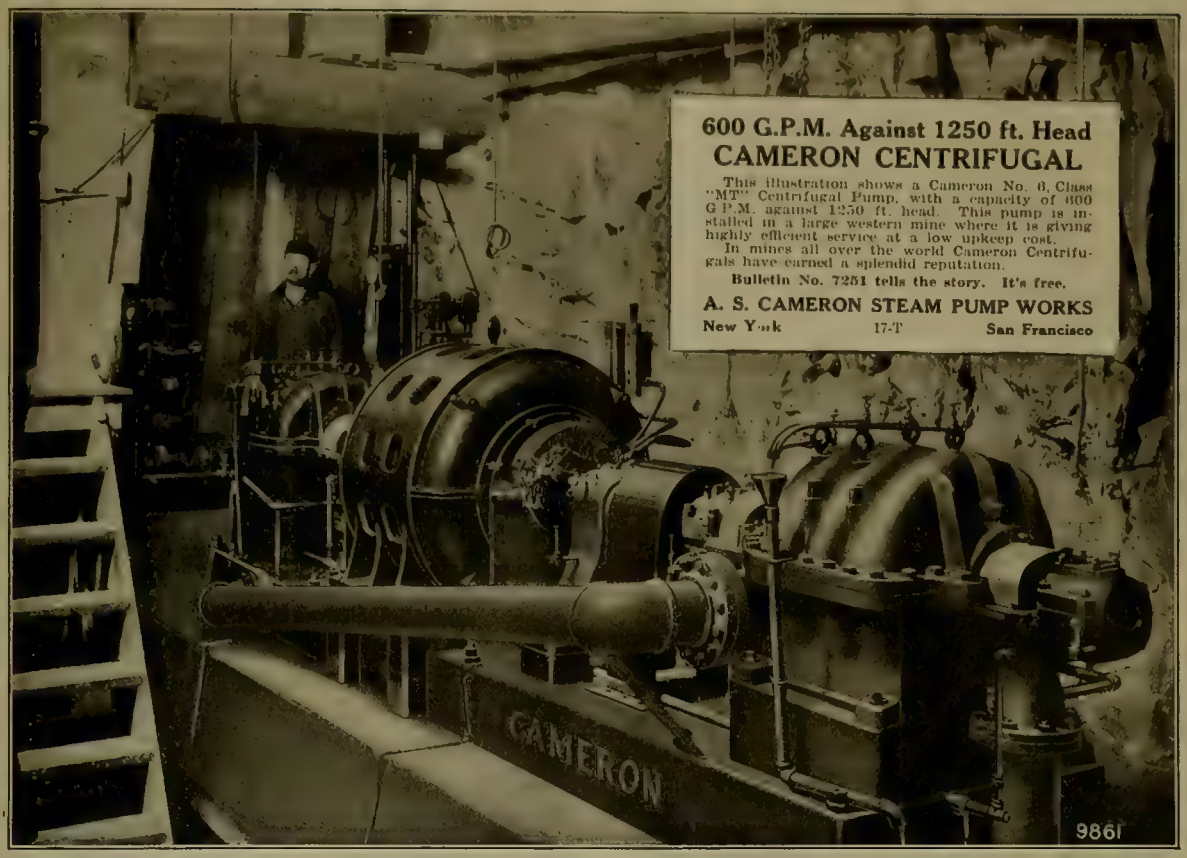
Paint, Preservative
Dixon Crucible Co., Joseph
Galigher Machy. Co.
Paraffine Paint Co.
Standard Oil Co.
Toch Brothers

Paints, Specialty
Paraffine Paint Co.

Pebbles
Atkins, Kroll & Co.
Hardinge Conical Mill Co.
Harron, Rickard & McCone

Perforated Metals
Allis-Chalmers Mfg. Co.
Galigher Machy. Co.
Hendy Iron Works, Joshua
Ludlow-Saylor Wire Co.
Meese & Gottfried Co.

(Continued on page 56)



600 G.P.M. Against 1250 ft. Head
CAMERON CENTRIFUGAL

This illustration shows a Cameron No. 6, Class "MT" Centrifugal Pump, with a capacity of 600 G.P.M. against 1250 ft. head. This pump is installed in a large western mine where it is giving highly efficient service at a low upkeep cost.

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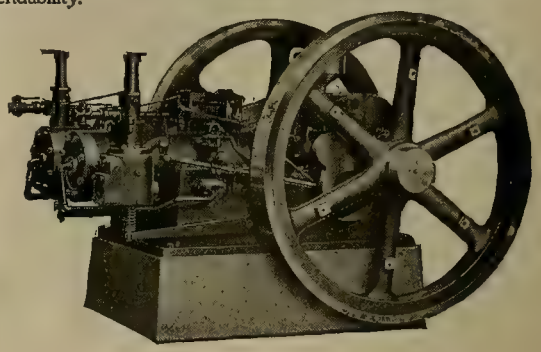
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R. R. SCHWEITZER,
General Manager



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National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Powell Co., Wm.
Sacramento Pipe Works
Smith, S. Morgan
Tay, George H.

Pipe, Air
Bemis Bro. Bag Co.
Tay, George H.

Pipe, Iron
American Cast Iron Pipe Co.
Buttress & McClellan
Tay, George H.

Pipe, Riveted
American Spiral Pipe Works
Galigher Machy. Co.
Hendy Iron Works, Joshua
New York Engineering Co.
Sacramento Pipe Works
Smith, S. Morgan

Pipe, Steel
American Spiral Pipe Works
Galigher Machy. Co.
National Tube Co.
New York Engineering Co.
Sacramento Pipe Works
Tay, George H.

Pipe, Wood
National Tank & Pipe Co.
National Tube Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.

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American Spiral Pipe Works
Angels Iron Works
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Morse Bros. Machy. & Supply Co.
New York Engineering Co.
Sauermann Bros.
Senn Concentrator Co.
Union Construction Co.
Yuba Manufacturing Co.

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Chicago Pneumatic Tool Co.
Harron, Rickard & McCone
Ingersoll-Rand Co.
Sullivan Machinery Co.

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Hercules Powder Co.

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Galigher Machy. Co.
Toch Brothers
Traylor Eng. & Mfg. Co.

Preservatives, Wood
General Naval Stores Co.
Pensacola Tar & Turpentine Co.
Toch Bros.
Traylor Eng. & Mfg. Co.

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The Ten Bosch Co.

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Denver Fire Clay Co.
Harron, Rickard & McCone
Mine & Smelter Supply Co.
New York Engineering Co.
Rix Compressed Air & Drill Co.
Union Construction Co.

Pulleys, Shafting and Hangers
(See "Transmission Machinery")

Pumps, Air Lift
Buttress & McClellan
Ingersoll-Rand Co.
Sullivan Machinery Co.

Pumps, Centrifugal
Allis-Chalmers Mfg. Co.
American Well Works
Buttress & McClellan
Cameron Steam Pump Wks., A. S.
Doak Gas Engine Co.
Frenier & Son
Galigher Machy. Co.
General Electric Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Jackson Iron Works, Byron
Krogh Pump Mfg. Co.
Meese & Gottfried Co.
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Oliver Filter Co.
Rix Compressed Air & Drill Co.
Tay, George H.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.
Yuba Manufacturing Co.

Pumps, Reciprocating
Allis-Chalmers Mfg. Co.
Angels Iron Works
Cameron Steam Pump Wks., A. S.
Galigher Machy. Co.
Garratt & Co., W. T.
Harron, Rickard & McCone
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Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Nordberg Mfg. Co.
Rix Compressed Air & Drill Co.
Tay, George H.
Worthington Pump & Mach. Corp.

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Atkins, Kroll & Co.
Braun Corporation, The
Braun-Knecht-Heimann Co.
Mine & Smelter Supply Co.

Quicksilver Furnaces
Hendy Iron Works, Joshua

Railway Supplies and Equipment
Atlas Car & Mfg. Co.
Harron, Rickard & McCone
Porter, H. K., Co.

Rams, Hydraulic
Galigher Machy. Co.
New York Engineering Co.

Rescue Apparatus
Bullard, E. D.
Elmer, H. N.

Roller Chain Drive
Meese & Gottfried Co.

Rolls, Crushing
Atlas Car & Mfg. Co.
Bacon, Earle C.
Bartlett & Snow Co., C. O.
Chalmers & Williams
Colorado Iron Works Co.
Denver Quartz Mill & Crusher Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Hendy Iron Works, Joshua
Morse Bros. Machy. & Supply Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

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Roofing Tin Plates
American Sheet & Tin Plate Co.

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Broderick & Bascom Rope Co.
Dodge Sales & Eng. Co.
Galigher Machy. Co.
Leschen & Sons Rope Co., A.
Meese & Gottfried Co.
Sauermann Bros.

Rotary Dumps, Pneumatic
Wood Equipment Co.

Safety Appliances
Bullard, E. D.
Elmer, H. N.
Harron, Rickard & McCone

Sample Bags
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Galigher Machy. Co.

Samplers
Braun Corporation, The
Braun-Knecht-Heimann Co.
Chalmers & Williams
Colorado Iron Works Co.
Denver Fire Clay Co.
Harron, Rickard & McCone
Mine & Smelter Supply Co.
Morse Bros. Machy. & Supply Co.
Traylor Eng. & Mfg. Co.

Saw Mill Machinery
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Meese & Gottfried Co.

Schools and Colleges
(See "Index to Advertisers")

Screens
Allis-Chalmers Mfg. Co.
Angels Iron Works
Bartlett & Snow Co., C. O.
Braun Corporation, The
Braun-Knecht-Heimann Co.
Cal. Perforated Screen Co.
Chalmers & Williams
Colorado Iron Works Co.
Galigher Machy. Co.
Harron, Rickard & McCone
Hendy Iron Works, Joshua
James Ore Concentrator Co.
Ludlow-Saylor Wire Co.
Meese & Gottfried Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Separators
Stearns-Roger Mfg. Co.

Shafting
(See "Transmission Machinery")

Sheet and Tin Mill Products
American Sheet & Tin Plate Co.

Shoes and Dies
Angels Iron Works
Chalmers & Williams
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Traylor Eng. & Mfg. Co.

Shovels, Electric and Steam
Harron, Rickard & McCone

Silex
Atkins, Kroll & Co.
Hardinge Conical Mill Co.

Silica
Jasper Quarry Co.

Sintering and Agglomerating Machinery
Dwight & Lloyd Sintering Co., Inc.

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American Zinc, Lead & Smelt. Co.
Beer, Sondheimer & Co.
Empire Zinc Co.
International Smelting Co.
Selby Smelting & Lead Co.
U. S. Smelt., Refining & Min. Co.
Vogelstein & Co., L.
Wildberg Bros.

Smelting Machinery
Allis-Chalmers Mfg. Co.
Colorado Iron Works Co.
Dwight & Lloyd Sintering Co., Inc.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Morse Bros. Machy. & Supply Co.
Pacific Foundry Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Sodium Cyanide
Lunkenheimer Co., The

Springs
American Spiral Pipe Works
Cary Spring Works
Harron, Rickard & McCone

Stamp Mills
Allis-Chalmers Mfg. Co.
Angels Iron Works
Buttress & McClellan
Chalmers & Williams
Colorado Iron Works Co.
Harron, Rickard & McCone
Hendrie & Bolthoff Mfg. & Sup. Co.
Hendy Iron Works, Joshua
Morse Bros. Machy. & Supply Co.
Straub Mfg. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Steel, Drill (Hollow and Solid)
Buttress & McClellan
Denver Rock Drill Mfg. Co.
Galigher Machy. Co.
Ingersoll-Rand Co.
International High Speed Steel Co.
Sullivan Machinery Co.

Steel, Tool
Galigher Machy. Co.
International High Speed Steel Co.

Suction Dredges
Krogh Pump Mfg. Co.
Union Construction Co.
Yuba Manufacturing Co.

Tanks, Cyanide
Buttress & McClellan
Chalmers & Williams
Dorr Company, The
Galigher Machy. Co.
Hammond Iron Works
Harron, Rickard & McCone
Koering Cyaniding Process Co.
Morse Bros. Machy. & Supply Co.
National Tank & Pipe Co.
Pacific Tank & Pipe Co.
Redwood Mfrs. Co.
Traylor Eng. & Mfg. Co.
Worthington Pump & Mach. Corp.

Tanks, Steel
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Galigher Machy. Co.
Hammond Iron Works

Tapes, Measuring
Galigher Machy. Co.
Lufkin Rule Co.

Thickeners, Pulp
Buttress & McClellan
Chalmers & Williams
Colorado Iron Works Co.
Dorr Company, The
Galigher Machy. Co.
Harron, Rickard & McCone
Koering Cyaniding Process Co.
National Tank & Pipe Co.
Oliver Filter Co.
Pacific Tank & Pipe Co.

Tractors
Yuba Manufacturing Co.

Tramways, Aerial
American Steel & Wire Co.
Broderick & Bascom Rope Co.
Harron, Rickard & McCone
Leschen & Sons Rope Co., A.
Morse Bros. Machy. & Supply Co.
Sauermann Bros.

Transits
Ainsworth & Sons, Wm.

Transmission Machinery
Allis-Chalmers Mfg. Co.
Chalmers & Williams
Doak Gas Engine Co.
Dodge Sales & Eng. Co.
General Electric Co.
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Meese & Gottfried Co.
Traylor Eng. & Mfg. Co

Trucks, Motor
Duplex Truck Co.
White Company, The

Tubes (Cold Drawn and Hot Rolled)
National Tube Co.

Tube Mills
(See "Mills")

Tubing, Air
Bemis Bro. Bag Co.
National Tube Co.

Tungsten
Hardy, Charles

Turbines, Hydraulic
Allis-Chalmers Mfg. Co.
Harron, Rickard & McCone
Smith, S. Morgan

Turbines, Steam
Allis-Chalmers Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.

Valves
(See "Pipe Fittings")

Ventilating Tubing
Bemis Bro. Bag Co.

Wall Board
Paraffine Paint Co.

Water Wheels
Angels Iron Works
Harron, Rickard & McCone
Hendy Iron Works, Joshua
Morse Bros. Machy. & Supply Co.
Smith, S. Morgan
Wellman-Seaver-Morgan Co.

Waterproof Coating
Smooth-On Mfg. Co.
Traylor Eng. & Mfg. Co.

Welding, Oxy-acetylene
Bullard, E. D.
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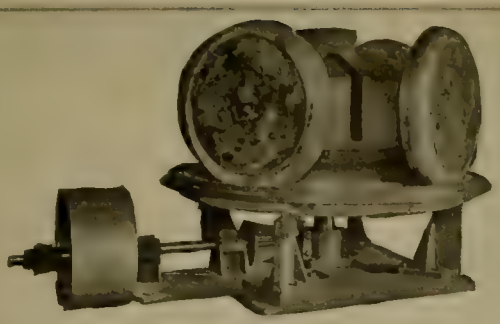
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(*News item in Mining and Scientific Press of October 20th issue.*)

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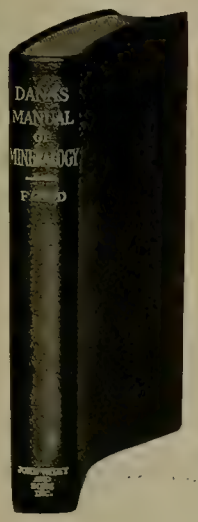
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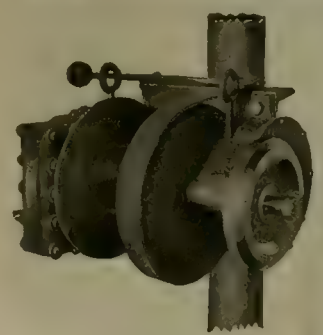
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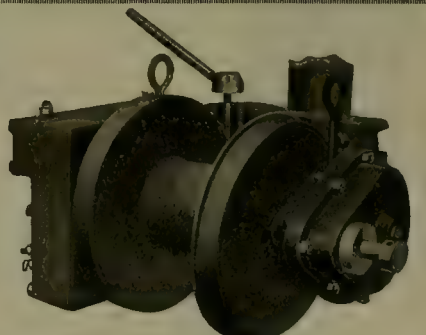
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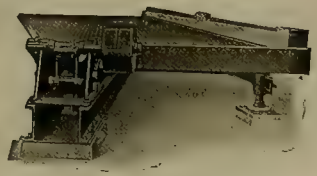
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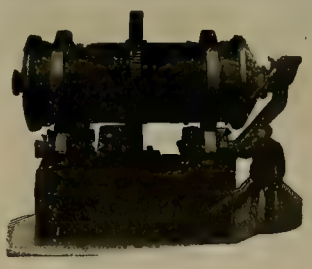
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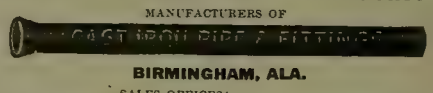
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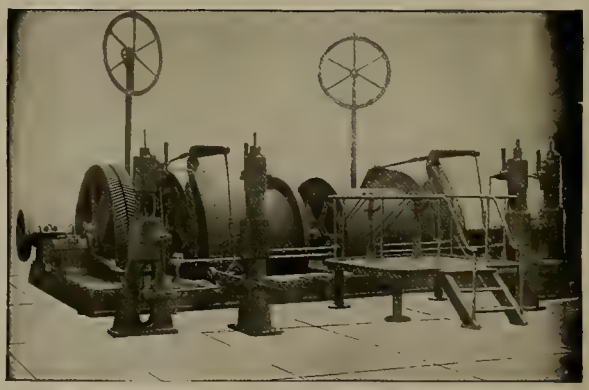
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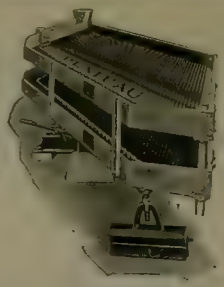
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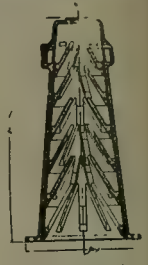
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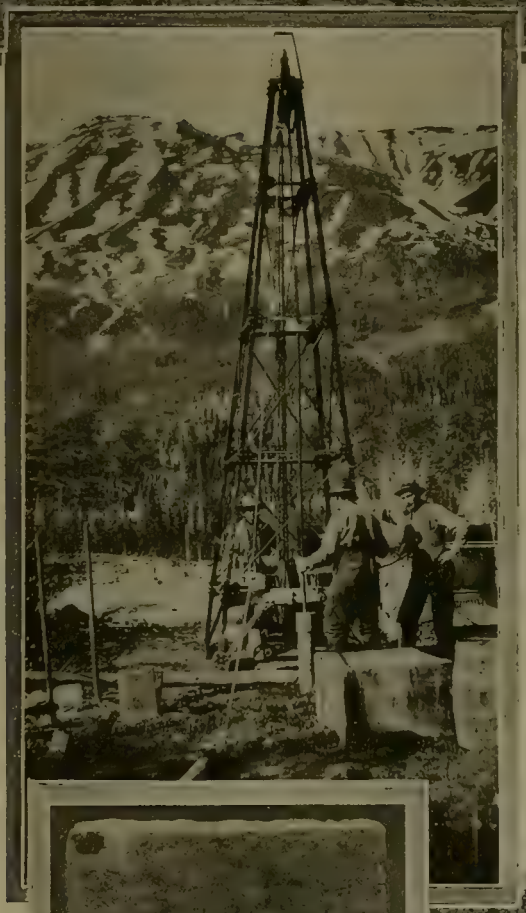
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EDITORIAL

"IT is a trite thing to say that we are not awake. We are awake. We know there is a war, but the thing is so big we do not comprehend it. We are asleep so far as recognizing the full significance of the figures is concerned—of understanding how gigantic the task is." So says Mr. Vanderlip. Every man that loves his country should daily put the question to himself whether he has grasped the magnitude of what is yet to be done to make the world safe and serene with the assurance of freedom to live worthily and in peace. He should ask himself whether he has done all that he might do to aid in ridding the world of crushing imperialism. The conscience and purpose of a democracy are the expression of the sentiments and purposeful activities that predominate among the individuals composing it. Let every man write the query "Have I done my best?" and put it where he must see and answer it each day.

RECOGNITION of the importance of training young men as technologists has been made by the War Department. Apparently the new regulation is well conceived to protect the country against depletion of its force of engineers and chemists. All technical students are accorded the privilege of enlisting in the engineers' corps, and after enlistment they may present a certificate of standing in their studies properly attested by the officials of the college or training school, accompanied by a petition for leave of absence until graduation. This permission is conceded automatically under the ruling of the War Department when the certificate presented shows that the academic grade of the applicant is as high as the upper third of the average grade of all students in the same school for the past ten years. This order disposes of one vitally important question in a manner that must win the commendation of all citizens that have thought seriously upon the larger problems of our national need.

SILVER has risen above 90 cents. The quotation appears to be responding to the intimation that the governments of the United States and Great Britain have arranged to purchase 100,000,000 ounces of the current year's production with a view to stabilizing the price of the metal; but we are informed that the Government, without specifying any definite quantity, is to authorize the Director of the Mint to buy all the silver that is offered. It is rumored that the price is to be fixed somewhere between 94 and 97 cents. China is an active buyer just now, shipments from San Francisco westward having been at the rate of five to six million ounces per month. Not more than one month's production—8,000,000 ounces—was available for the coinage needs of our own government and that of England, so that the rise to $1.15 in September was not surprising and it might have continued even to $1.25 if an artificial check had not been established. The miners of silver protested against this interference with their opportunity to obtain compensation for the low prices previously prevailing and expressed a keen desire that official hands might be kept off the market. We understand this point of view, but believe it to be short-sighted. The fixation of the price at a moderately high figure, double the lowest quotation of three years ago, is better for the mining industry than a hysterical market affording no assurance of steady profit. As we announced in a recent issue, credible gossip in financial circles arouses expectations of an international agreement for a bi-metallic monetary basis. Thus, and thus only, could the two metals be associated so as to bolster the credit requisite for the expanded volume of international finance. There was no doubt that France was favorably disposed toward bi-metallism, if Great Britain would follow suit. The indications now point toward an understanding on this subject among all the allied nations.

COPPER mining at the Calumet & Hecla is the subject of a short article appearing in this issue from the pen of an experienced journalist, Mr. Homer Guck. He tells the story of the great copper mine that has given fame to the Lake Superior mining region and incidentally refers to the accident of discovery, through the unearthing of a 'cache' or store of copper by an enterprising pig. Edwin J. Hulbert is given as authority for this tale. It does not conflict with the account given to the present writer by James D. Hague. In 1853, while surveying for a road, Hulbert had found detached pieces of copper-bearing conglomerate and in 1858 he discovered the so-called ancient pit, which may be the same as the hole in which the boarding-house pig prospected with his snout. Such evidences of the existence

of a copper lode did not lead at once to the discovery of ore in place, for this did not follow until August 1864, when Hulbert sank a prospect-hole on a tract of mineral land that he had selected for exploration, and struck the Calumet conglomerate. Fortunately the ore was so rich at the point of discovery as to encourage development. However, the first ore produced for market from the Calumet lode was mined at the bottom of the 'ancient' pit early in 1866. It yielded 12% of copper. Thus, while the pit contained a 'cache' of copper, mined elsewhere, it happened to have been dug at a spot immediately above the copper-bearing conglomerate, but not so deep as to expose ore in place. This recalls the story of Chicken Bill and the Chrysolite, at Leadville. Our readers will remember that H. A. W. Tabor bought a claim, called the Chrysolite, from a notorious prospector called Chicken Bill. This enterprising person had not waited for his shaft to reach the ore-bearing limestone, but had taken rich ore from the Little Pittsburg mine and had 'salted' the bottom of the shaft. Tabor was deceived and paid $40,000 to Chicken Bill, who then began to brag about his trick to some of his friends, so that the news of it reached Tabor's clients before he himself reached Denver, whereupon they repudiated the deal and Tabor had to keep the claim. He sank the shaft deeper and struck wonderful ore—this time in place! The Chrysolite yielded $1,500,000 in profit to Tabor and his associates before they sold it to a New York company for another $1,500,000.

Mexican Conditions

Mexico is said to be emerging from political chaos, but her economic condition is deplorable. A recent traveler, competent to judge through long familiarity with the Spanish language and the ways of the country, informs us that no real progress in reconstruction is being made. The Mexicans assumed that they could apply the magic touch of a socialistic constitution and, presto! the resources of the mine and farm would leap into the mints and granaries. The little matters of capital and industry and discipline were quite overlooked. It was to be expected that the socialists would disdain the need of capital, since they blame most of the disappointments of man upon the capitalistic system, without in the least comprehending the true meaning of capital nor realizing the wrong construction that persistently has been put upon the teachings of Karl Marx by his avowed disciples. At all events the Mexican free-for-all non-capitalistic handicap is proving a dead failure, and the people are cooling down to a point where the governmental leaders can explain to them the need of help, even from the 'gringo.' Our correspondent remarks that the Mexicans are beginning to see that, "in asking for help it must be on the understanding that the management, and the control of funds and revenue, will be demanded and required." 'Mexico for the Mexicans' is an excellent slogan, but it has nothing whatever to do with the peaceful and normal development of their natural resources by outside capital. If the Mexicans will set aside their impossible constitution of Querétaro, swing back to the bill of rights in the constitution given them in 1857 by their true patriot, Benito Juárez, eliminate the principles of monopolistic concessions, thereby at one stroke cutting off the main artery of graft that has brought them so much evil government, they may hope to see their country arise from her desolation. It is not the wish of the people of America that Mexico should be humiliated, nor that it should be over-run by our army and annexed. The fact that we were able, when sufficiently stirred by a genuine national peril, to put on the trappings of war and display a strength before which any small nation might well stand abashed, is proof enough of the national attitude of mind. We do not even hint at an invasion of Mexico, although we are now in warlike temper. Mexico knows that she is safe against attack from her big neighbor of the North, despite the inconsiderate statements that sometimes creep into the daily press. We regret, for example, the intemperance of certain reporters who recently have made 'copy' out of ridiculous imputations to Governor Cantu of Lower California of a wish to offer his 'principality' to this country. Such nonsense, written by boys who are more smart than learned, and who know nothing of the history of Mexico and of the special fervor of her patriotic sentiment, utterly misrepresents both countries. Governor Cantu is a man of unusual intellectual gifts, a thoroughly progressive man, and so well disposed toward America that he is offering to supply us certain raw materials that we need; but he is also a Mexican, and the last thing a Mexican would do is to relinquish so much as a rock or a sand-spit of the Patria to a foreign power, save under compulsion of arms. Whatever family quarrels Governor Cantu may have with his political associates he is no traitor to his country, and the American people would despise him if he were. Mexico needs our kindly assistance at this moment, and we believe that she will look to us for the sort we can best render as soon as Argentina shall have cast to the winds the fiery anti-American doctrines of Manuel Ugarte and have aligned herself with the powers contending against Kaiserdom. Mexico needs, not only capital, but a close association with our banking system to re-introduce the machinery of credits, without which industrial recuperation is impossible. Just now the authorities have adopted make-shift means for obtaining a considerable amount of American gold coin through their customs and tax departments, and are endeavoring to re-coin it as fast as it can be delivered to the mint in Mexico City. This resource, however, is relatively small, since the exportation of gold from this country is permissible now only upon special executive order, and that is not conceded unless the circumstances render it peculiarly necessary. Practically, Mexico is dependent upon the gold produced from her own mines, and upon a return of 25% of exported silver in a gold equivalent,

and that equivalent amount constitutes the larger part of what is obtainable under export licenses, to which is added the quantity required to save American investments on which payment of taxes in gold is obligatory, which amounts to a little over $10,000,000 per month. If not paid, and in gold, the property is, by decree of Carranza, subject to forfeiture to his Government. In order to stabilize Mexican currency the fiat paper has been retired, but the basis for bank-credits in proper proportion for a large expansion of industry is lacking. The banks are endeavoring to liquidate their outstanding circulation as rapidly as they can, and some are buying up their bills at a given rate in the open market, while others remain dormant, anticipating better conditions. We are finding that conscription of capital is impossible, and Mexico has found that its twin sister, confiscation of capital, is impossible. Such drastic actions result in extinction of the country's resourcefulness. It is in the encouragement of industry, and in the creation of confidence whereby the resources may multiply their usefulness as bases for credit, that the real ends of national development are subserved. The interests of Mexico and the United States are inter-related because of propinquity and because of the complementary nature of the resources of each country. For purposes of finance no wide division can be drawn between them without mutual harm. As friends and allies we can be of assistance to each other, and our financial support will ensure the growth of a free and prosperous Mexico. The questions of reform have nothing to do with the gringo; these depend on the wisdom of the Mexicans themselves.

Geology at Jerome

Truth is stranger than fiction and facts are more romantic than fables. In this issue we conclude the story of the U. V. X. bonanza, telling how the wonderful orebody of the United Verde Extension mine, at Jerome, Arizona, was found by Mr. James S. Douglas. The thoughtful reader will not have overlooked the strange coincidence whereby James Douglas, the elder, missed getting hold of the United Verde, which William A. Clark acquired, to his great enrichment, and how Mr. Clark missed the riches in the United Verde Extension, so that it was left for James Douglas, the younger, to unlock that treasure-vault. "The whirligig of time brings in his revenges." We may remark, however, that both Dr. James Douglas and Senator Clark, as they are now known, were so successful in their mining operations elsewhere that the rejection of the United Verde by one of them and the missing of the United Verde Extension by the other have not proved disappointments of a tragic kind. Still we rejoice that the final achievement was left to the younger man and to his friends, so that the wealth of Arizona has found wider distribution. If there must be a moral to the story it is that the miner should not disdain the aid of the geologist. Senator Clark in vulgar phrase 'had no use for' geologists. That is accountable in part by his unpleasant experience with Mr. George W. Tower, of the U. S. Geological Survey, at Butte; for that geologist had access to the Clark mines in his official capacity, and when he resigned from the Survey he used his information as an expert witness in the local mining litigation, which at one time had many of the characteristics of a vendetta. That may excuse the Senator's strong prejudice during recent years, but not his earlier inhospitality to geologists, whether official or unofficial. The late S. F. Emmons, a man to whom the Tower episode, made known in 1903, seemed a blow at the honor of the Survey, being himself most scrupulous in his use of information obtained as an officer of the Survey, records regretfully the fact that Mr. Clark's policy of excluding visitors, especially geologists, from the United Verde, prevented him from studying the evidence of secondary enrichment existing in that mine. That was in 1899. It is significant that when H. H. Rogers was organizing the Amalgamated Copper combination in 1898 he proposed to include the United Verde, but the negotiations broke down when Senator Clark refused to allow an examination to be made. So geologists were persistently excluded from the United Verde, and the Senator was so prejudiced against them that he did not employ one to guide him or his manager in the development of the mine. The consequence was that the combined effects of geologic faulting and secondary enrichment were not correctly apprehended, and it remained for a mining engineer from the outside to come into Jerome and uncover the bonanza under the noses of the people that had been exploiting the United Verde for 25 years. We do not insist that all the geologists made correct inferences; the story of the U. V. X. discloses the fact that several of them—and some pretty good men too—guessed wrong; but that is to be expected, seeing how young the science of ore deposits is and how uncertain are many of the criteria on which it is based. Still the U. V. X. remains a triumph of sound observation and scientific reasoning; it is far removed from the lucky accidents that started most of the great mines of the West, from the Comstock to the Camp Bird. The enterprise organized by Messrs. Douglas and Tener is also noteworthy as a clean promotion and a straightforward piece of business. It was conducted on a high level of integrity from start to finish; affording a good example to other incubators of mining adventure. It is not the fault of Messrs. Douglas and Tener if the U. V. X. has been used as an excuse for breeding a vociferous litter of wild-cats. The promoter of a puling prospect can point—and has not hesitated to do so—at the U. V. X. as a rich mine that was started on nothing, a successful development predicated on no surficial showing of ore; and, as one might expect, the so-called fiscal agents and other organizers of hair-brained schemes for collecting money from the public have used the U. V. X. story as an argument that can only be answered by those aware of the facts. The publication of the real story should serve to check a distortion of the truth, while at the same time offering encouragement to intel-

ligent exploration. The idea that there are 'one mine' districts—that a single mine may include within its boundaries all the rich ore in a given locality—is a notion that should be thrown aside. If it were given to the miner for an instant to have a radioactive vision enabling him to see into the crust of the earth, he would, we think, be astounded to see how much ore he had missed, even close to the workings he had made. Probably the undiscovered ore greatly exceeds that which has been mined, could we but see it, which is equivalent to saying, could we but find it without spending an excessive amount of money in the search. The geology of the Jerome district is yet to be deciphered. For that the microscope of the petrographer is necessary. Several experienced geologists have examined the district recently, and even the United Verde can now boast a competent guide in these matters, so we shall hope that fresh evidence will be produced, to the end that a clear and comprehensive explanation of the rock-structure may become available. The energetic prospectors along the line of the big fault need such help, and they ought to have it. Undoubtedly they would have had it long ago if the United Verde had not been closed to the U. S. Geological Survey; and now that the U. V. X. is open to official inspection the Director of the Survey should lose no time in delegating members of his staff to make an examination. Timeliness is essential to a geological report. Delicately worded obituaries and meticulous post-mortems are not in demand by those engaged in the operation of mines. It may be that Mr. Douglas's venture will furnish scientific evidence of great value, as well as much copper for making the munitions to be used in the achievement of victory on the battlefield. He undoubtedly is glad to have his copper put to military use, for he is a large-scale American whose heart is in the Great Cause—and more than his heart, for his son is in the U. S. Army, and he himself, leaving the accumulation of millions, is in France, serving the Red Cross with a bigness of spirit that is more than all the wealth of a copper mine, even of the one with which his name will remain forever linked in honorable fame.

Excess-Profit Tax

Referring to the incidence of this tax on mining, we have expressed doubt concerning the practicability and fairness of the Act passed by Congress on October 3. It is a pleasure, therefore, to record the fact that a committee representing the mining, oil, and gas industries was organized early in December under the auspices of the American Mining Congress to discuss the matter with the Advisory Board of the Bureau of Internal Revenue. The committee consisted of the following representative men: J. J. Shea (Oklahoma), A. G. Dickson (Pennsylvania), Herbet Pope (Illinois), Ravenel Macbeth (Idaho), A. G. Mackenzie (Utah), Emmet F. Boyle (Nevada), T. A. Dines (Colorado), A. Scott Thompson (Oklahoma), Victor Rakowsky (Missouri), Paul Armitage (New York), Archibald Douglas (Arizona), and Albert Burch (California). After a conference with the Advisory Board, the committee was asked to formulate such an amendment to the present law as would be satisfactory to those engaged in mining. We do not repeat the reference to "oil and gas," because the exploitation of oil and gas deposits is 'mining,' and the distinction attempted to be made is a technical blunder. The amendment of Section 207, of Title 2, of the Act, was as follows: "That in the case of mines, oil and gas wells, the invested capital, at the option of the tax-payer, shall be (1) the average pre-war net income capitalized at 8%, and (2) paid in or earned surplus and undivided profits used or employed in the business since the pre-war period, exclusive of undivided profits earned during the taxable year; provided, that in the case of mines, oil and gas wells, having no pre-war net income, or acquired since the pre-war period, the 'invested capital,' at the option of the tax-payer, shall be (1) the net income for the year 1917 capitalized at 12%, and (2) paid in or earned surplus and undivided profits used or employed in the business subsequent to the year 1917, exclusive of undivided profits earned during the taxable year." This is not an amendment that can be approved, for it attempts to define while using terms that themselves need definition; moreover it will bear inequitably upon individual mines and is unlikely to meet the requirements of the Government. A later suggestion, made by Mr. Albert Burch, who was unable to be present at the conference, reads thus: "In the case of mines, oil and gas wells, the increase in the average price received at place of sale for each unit of product, that is, each ounce, pound, ton, barrel, or cubic foot, as the case may be, for the taxable year over the average price at which the same unit was or could have been sold at the same place during the pre-war period shall be ascertained, and 50% of such increase multiplied by the number of units produced and sold during the taxable year shall be deemed War Excess Profits and upon such War Excess Profits there shall be paid a tax in lieu of all other taxes imposed under this title at a graduated rate from 20 to 60%, varying with the percentage of increase in unit-value of product." Thus the factor of 'capital' is eliminated from the problem and those that have benefited most from the increment of prices due to the War are mulcted most heavily. The 50% of profit that is untaxed is supposed to be absorbed by the increased cost of production. There should be no difficulty in applying this definition, which, once and for all, escapes from the verbal morass in which the tax-gatherer and the tax-payer are floundering. Misconception as to the significance of capital invested in mining has led persistently to false reasoning in tax apportionment. Invested capital is fixed like the mine in which it is invested. It is the working capital that gives it the vigor to become productive. Working capital, however, is subject to wide variation, and is not a basis for equitable taxation, but it is logical to demand contributions from income, because that is the true measure of utility.



How to Ship Ore

The Editor:

Sir—There appears to be a dearth of knowledge at the mines concerning the condition of shipments of ore and mill-products and the kind of containers best suited to the needs of the sampler and consequently to the general satisfaction of both shipper and smelter. A good many shippers appear to think that the condition of the ore or concentrate or precipitate, as the case may be, is immaterial, so long as the stuff is loaded on the cars and sent on its way. I venture to make some suggestions that may appear superfluous to the initiated, but which to a surprising extent might be followed with resulting satisfaction to both shipper and smelter.

Starting with crude ore, the first requisite is uniformity of size, and the finer the better. Recently I noticed a shipment of silver ore from a Nevada prospect, the owner of which had installed a small crusher at the shaft; the ore was crushed to a maximum of one inch, sacked in good strong sacks, which were plainly marked, and loaded in four lots in a car, each sack bearing its lot-number. There was a feeling of satisfaction among the men in charge when this shipment was unloaded and sampled at the smelter.

About the same time another shipment was received from one of the oldest shippers on the Coast, supposed to contain three lots in a car. Some of the sacks had no mark on them, and nearly all were so rotten that it was impossible to carry them from the car. Of course, the best the man in charge could do was to make an approximate segregation of the lots after corresponding with the shipper. In this case two 12-in. boards would have made a perfect division of the three lots, and the sacks could have been dispensed with entirely.

In regard to marking sacks, where there are several lots in a shipment. One of the best methods is to tear up an old pair of overalls and tie a strip of the cloth to each sack. Another lot could be marked with pieces from an old red flannel shirt, and a third lot might be left with no marks. I have just seen the sampling of a shipment of concentrate that illustrates this point very nicely.

One of the large mining companies operating in Mexico shipped 578 sacks of concentrate on July 16, 856 sacks on July 23, and 670 sacks on August 6, each lot representing the output of the mill for a given period. Of course, these lots should have been kept separate in order that the mill superintendent could check the returns against his assays, but the steamer loading the lots at the Mexican sea-port got them hopelessly mixed. On arriving at the smelter the only segregation that could be made was to take the number of sacks called for in each lot, as there were no distinctive marks. The first lot sampled was over a ton and a half short in weight and lacked some 1200 oz. silver in content, which fact elicited a prompt inquiry from the mining company. However, on checking the total weights of the three lots, there was nearly one and a half tons over the advised weights, and I have no doubt that the total value of the three lots will be satisfactory. Companies making regular shipments of concentrate from a distance, as in this case, should use linen tags on which the lot-number could be stamped.

Concentrate should be shipped in double sacks, or, in case of local shipment, preferably loose in the car, provided the car has a good floor. The car should be swept clean before loading and boards should be placed before the doors to prevent leakage.

Shipments of flotation concentrate are becoming increasingly important, and in this connection I want to point out a fact that merits consideration at the mine. I have noticed that some millmen, in their zeal to lower the freight-charges as much as possible, have dried the concentrate, apparently at a good deal of trouble and expense, to as low as 1% moisture. Believe me, that is dry. I saw such a lot of very high-grade flotation concentrate unloaded at one of the smelters recently. The stuff was loose in a box-car, and the wind was blowing, so in spite of all precautions in unloading, I believe there was a loss sufficient to pay a considerable part of the freight-bill. Then the lot had to be wetted before sampling, and as the metallic particles are coated with oil, it was almost impossible to accomplish the wetting, the result being a rather messy business all around. On the other hand, the moisture content should not be over 12%, but this is easily attained with the vacuum-filters in general use. I should say from my experience that the most satisfactory condition as to moisture for shipping and sampling is about 5 or 6%.

Regarding cyanide precipitate, the same suggestions as to moisture will apply, only with added emphasis. This product should not be dried completely nor should it be shipped wet. I have noticed recently several lots containing over 40% moisture. These lots must be dried carefully and screened before sampling. It is hard for the shipper to realize that his precipitate, worth probably $40 per pound, has lost 40% in weight before being sampled.

I believe the best container for precipitate is the five-

gallon oil-can, with the carbide-can a close second. These are convenient and safe. Usually the handiest receptacle around a cyanide plant is the empty cyanide-can, but these cans filled with precipitate will weigh up to 350 lb., which is entirely too much weight for the cans or the cases enclosing them. In shipping this class of material it is advisable to mark the cases plainly, giving gross, tare, and net weights, so that the sampler or the shipper's representative may check the weights and notice any discrepancy at once.

Almost every mine in the country enjoys an individuality in regard to the shape and size of its bars, but as I have noticed an apparent desire on the part of the smelters to standardize to some extent the size of the silver bullion bars, I will give the approximate dimensions of the bar that appears to be the most satisfactory for the individual melting and sampling, as practised at custom smelters. A bar 4¾ by 16½ in. long on the bottom, and 4¾ in. high will weigh about 2000 oz. This applies to the class of bullion produced at the silver mines of Nevada, Arizona, and Mexico. Each bar should be stamped with the mine number and weight. If there is matte on the bars it should be removed and shipped separately when enough has accumulated. The matte is easily ground and sampled as one lot of ore.

FRED G. TYRREL.

San Francisco, December 21, 1917.

Mineral on Agricultural Land

The Editor:

Sir—Your editorial comment, in the issue of December 1, upon Leonard G. Blakemore's letter concerning 'Prospecting Conditions in California' is timely and interesting. I quite agree that retroactive regulations are contrary to our fundamental law, but, on the other hand, I question whether the miner will find any relief through the exception of minerals in any future agricultural patents, by reason of the fact that such has been already ineffectually tried. Thousands of U. S. patents to agricultural land have already been issued with clauses excepting the minerals, and yet no miner has been able to acquire title to the minerals contained in them. I refer not to the oil lands, which are frequently difficult of mineral determination but to the thousands of acres of mineral lands held by the Southern Pacific Co., and acquired by them as agricultural lands by means of sworn affidavits as to their iron-mineral character. Aside from the exception of minerals contained in these patents, I maintain that the title to the minerals in them has not and could not pass to the railroad company, for the reason that by an act of Congress, still in force, all mineral lands are reserved from purchase, sale, or grant, and can be acquired only under the mining laws, which require discovery, proper locating, assessment work, and the rest. In no other way can title to mineral lands be acquired, as provided by statute. Therefore, mineral lands held by any other shadow of a title are not legally held, and are open to location and to perfection of title by any citizen of the United States. The Government should lend every possible aid to the discoverer of mineral and protect his rights to the acquiring of these minerals where wrongfully claimed under patents issued for agricultural lands.

Men are drafted, ships commandeered, steel and food prices regulated; why then should not the Government aid the miner in procuring title to mineral land when found on lands acquired through agricultural entry. If this class of land was patented as agricultural, and sworn affidavits were made as to its non-mineral character, why are so many portions of it being operated today for minerals under mineral leases issued by the Southern Pacific Co.? In order to protect innocent third parties who have already purchased some of these so-called agricultural lands from the Southern Pacific Co., why would it not be advisable for Congress to enact that, after a certain date the mineral portions of such so-called agricultural patented lands should be open to discovery, location, and mineral patents issued in compliance with law.

PROSPECTOR.

San Francisco, December 6, 1917.

A Plea for Labor

The Editor:

Sir—The discussions and editorials on labor, in your issues of November 17 and December 8, should be read by all who have anything to do with the handling of men. I agree, in the main, with what both your correspondents, J. F. Harrington and 'A Miner' write, but consider there is a field for the contract system in every mine, if this privilege is not abused by those in charge of operations. What 'A Miner' says about the old worn-out men being consigned to the scrap-heap, is, in many cases, only too true, and I can quite realize how he feels about the contract and bonus systems. We are living in the age of the young man, and this applies especially to the Western States—an age when energy and the new science called 'efficiency' are the chief factors; an age of getting things done, without stopping to consider what the ultimate results of the methods employed may be. There should be a place, and a good one at that, in any mine, for men like 'A Miner'; or are those that have passed the prime of life no longer of any use? Young men for energy, and old men for judgment and counsel, and a proper blending of the two is good to keep the balance. "The glory of young men is their strength; and the beauty of old men is the gray head."

The cost-sheet, which is the whip over the back of the superintendent, only tells part of the story; perhaps the other part will remain untold until the great Book of Life is opened. We are laying too much stress on efficiency and the material side of things, and seem to forget that everyone has a right to a living, preferably in the occupation to which he has been trained, and if we are not careful, there is a danger of being caught and over-

whelmed by that wave of materialism which has gradually wrought such disaster to Germany as a nation—a nation that fills one with such dread and horror, that even education, which, during the last decade has been looked upon as a panacea for all evil, is now being questioned when one realizes what it has not done for Germany. "There is a reason", to use a phrase of one of our clever advertisers, why, in order to pass the local examinations of the great English universities, the candidate has to "satisfy the examiners in the rudiments of faith and religion." A sound knowledge of other subjects, minus this, is futile. Perhaps they realize that even such an excellent thing as education requires a good foundation in order to withstand the stress of time and storm.

When I was in New Zealand some years ago, most of the work in the mines, including the stoping, was done on contract, and I attribute the spread of this system, in preference to the wages system, to the scarcity of efficient shift-bosses. As Mr. Harrington points out, it was a case of getting contractors to do the supervision and the "driving". My experience of contracting has caused me to form the following conclusions: that the system has a tendency to eliminate the old and the unskilled men; to increase the wages of the workers; to decrease the cost of the work done. For such work as cross-cutting, shaft-sinking, and any work where valuable ore has not to be handled, I have always favored contracting; but for stoping and driving on ore one needs a better guide than the cost-sheet to find out whether it is an economical system. I have tried stoping by the ton and by the fathom, sometimes with wages-men to take care of the ore, but would far rather do this work with wages-men, who have the company's interest at heart, even if they are old men that are getting beyond the energy of youth.

The method of letting contracts is often much abused. A contract should be a contract, and binding on both sides. Prior to the establishment of the Arbitration Court in New Zealand, a mining contract was a somewhat one-sided document; it was usually a list of printed conditions with spaces left out for filling in the specifications of the particular piece of work being let. One of the conditions was that the company could stop a contract at any time without compensation to the contractor, the excuse for this clause being that the workings might become inaccessible owing to water or bad air. At a meeting of employers, held during a serious dispute between the companies and the miners, I called attention to the unfairness of this 'no compensation' clause, and as an illustration, quoted the case of a party of contractors who had sent a long distance for their 'mates' and paid their traveling expenses, only to find that, after, about 10 days, the contract was stopped. When these 'Conditions of Contract' were investigated by the Arbitration Court, the Judge promptly objected to this particular clause, and it had to be eliminated. Another contract feature that the Court frowned upon was what is known as the 'monthly take' system, which applies to driving and stoping let by the month. The union representatives were particularly bitter against this system, and, after hearing whole volumes of evidence, the Court knocked it out. The chief cause of complaint on the part of the men seemed to be that if they made good money one month they were cut down the next, and that the system gradually developed a species of 'soldiering'. At one large mine there was a system of letting large stoping contracts, usually taken by four to six men as contractors, these employing a sufficient number of wages-men to supply the required tonnage. These wages-men were paid more than the standard, as fixed by the Arbitration Court, but, notwithstanding their good pay, they developed dissatisfaction because the contractors, who, they claimed, were doing just the same work that they were, made more money. They termed it "blood money" and said the contractors were growing fat out of their labor. This proves that in some cases men will have just as much of a grievance against each other as against overbearing 'capital' as represented by a company.

There are, of course, many men who will shirk and not do a good day's-work if they can avoid it, but I have always found that if one is fair it is possible to get good men, and with a combined system of wages and contracting there is a place for both the young and old. I do not agree with 'A Miner' that contracting, or even the bonus system, is necessarily 'killing' to the worker —nowadays we all have the 8-hour day, and I believe most men can stand 4 hours at a stretch, of even contract work, without harmful results, provided they have ventilation and other good working conditions.

Young and selfishly ambitious superintendents and bosses sometimes abuse the contract system, and it is in this direction that the more elderly officials of a company—the directors, for example—might give some supervision, using their judgment to curb the energy of youth. Any one who will read the story of Rehoboam and Jeroboam, as recounted in the 12th chapter of the first Book of Kings will realize that the counsel of young men sometimes lacks that wisdom which is essential to true success.

F. C. Brown.

Silver City, Idaho, December 14, 1917.

Flotation

The Editor:

Sir—I take pleasure in submitting to you some of the thoughts engendered in my mind by the perusal of your book on 'Flotation.' I have been interested more particularly, as you know, in the precise function of oils when chemical additions are made to the pulp, and in the reasons for the different grades of concentrates resulting from the use of various brands of oils.

Sulphuric acid may cause adsorption, say, of positive ions on the sulphide particles and consequently if the surface-concentration of the ions is sufficiently large, that is to say, if the critical contact-area is exceeded, the sulphide particles will manifest an induced attraction for and a migratory tendency toward the negative bubble-

films, when the ions are firmly adsorbed. By 'critical' contact-area I mean that minimum area of contact between two substances, *A* and *B*, beyond which one substance *A* will impart to the other substance *B* its own polarity, that is, the polarity of *A*. This concept of the function of acid would explain directly the improvement in the grade of a concentrate, although I do not disregard its beneficial effect in wetting the gangue, affecting the degree of flocculation and the surface-tension, in cleaning the sulphide surfaces, and in altering the viscosity of the oiled films. Where acid is beneficial the use of lime may be detrimental by causing a different degree and kind of ion adsorption; both acid and alkali may have a good or ill effect by chemical inter-action with the pulp.

When different oils are used the important causes of varying recoveries may lie in the different viscosities of the bubble-films, and in the varying degrees of adhesion of the oil to the sulphide particles. These two factors seem to merit most attention, although electro-static charges may in some cases be not without their influence. The grade of concentrate may depend also on mechanical manipulation of the flotation machine. With too thin a bubble-layer, that is, too high a pulp-level, fine gangue-particles may be literally bombarded over the lip of the cell. The use of a large amount of air has a similar effect, especially if the froth is at all viscous, for the finest gangue-particles are projected into it and remain entangled there. The froth-cleaner cells should always have a thick blanket of froth, which is made to overflow gently, and the bubbles should preferably be somewhat brittle. This would give any granular gangue-particles time and opportunity to slide back into the pulp. With a higher heading-value a better concentrate is obtained because, for one thing, the froth being more uniform, the cells are so much the easier to control. Then, again, with a comparatively rich feed, if much air is not being used, and if we have an oil that does not yield a voluminous froth, the grade must be higher, for the sulphide particles being preferentially attached to and covering the bubble-film there is less exposed surface to which the finest gangue-particles in the pulp can adhere. It seems to follow that the amount of froth that should be produced is a function of the richness of the feed. I took some flotation-concentrate assaying 6% copper and re-floated one portion after adding sodium carbonate, and the other after adding sulphuric acid, obtaining two concentrates of practically the same grade. In this instance, therefore, alkalinity or acidity of the pulp had, per se, no different influence on the results. The electrolytes may be assumed to have modified the bubble-films in the same way.

Thinking that by baking the rougher-concentrate before re-floating I might produce a markedly cleaner concentrate, I tried the idea, but with no success. I should like to have an explanation of the following: Into a filtered solution (in an assay of copper by the cyanide method) I put a small drop of Barrett No. 4 oil and, at once adding the ammonia, shook the flask for a minute. The solution seemed to be quite clear. On adding one cubic centimetre of the cyanide solution a faint opalescence appeared; this, with further addition, developed into a dirty-green very fine precipitate, which was filtered off and the titration finished. A second assay was run without an addition of oil; the results were:

With oil .....3.4 cc. KCN necessary
Without oil .....3.9 cc. KCN necessary

In the former instance, was the copper included by the emulsoid as cuprous ammonium hydrate?

When a complete analysis of flotation-concentrate is desired I should like to point out something that is often overlooked. The froth should be broken down and well-washed with distilled water, otherwise to the legitimate sample there will be added the soluble salts that are precipitated on evaporation of the solution. Where no precautions are taken the assay-value, for example, for the alumina content may be fictitious, especially in froths derived from an acid pulp.

Paul T. Bruhl.

McGill, Nevada, November 25, 1917.

Heap Leaching of Copper-Sulphide Ores

The Editor:

Sir—I have read with great interest the long and interesting article on the above subject in the Mining and Scientific Press for November 24. While agreeing with the article as a whole, I beg to submit herewith one or two corrections.

1. With regard to recovery, one is apt to read at the beginning of the article that 80% recovery has been demonstrated in actual work of eight months. If, as a result of the experimental work, the sentence, page 749, should read, "the entire process has demonstrated a 'probable' recovery of 80% of the copper in the ore," it would be clearer. Of course the sentence at the end of the first paragraph on page 757 may make it perfectly clear to the careful reader that the 80% recovery is expected in about two years.

2. While admitting the possible formation of metallic copper in the heap, one must always remember that an increase of the same agent, $Fe_2(SO_4)_3$, that helped to produce the copper will also dissolve it, see the equations 5, 6, and 8, page 755, and so this possible evil "dies aborning."

Joseph Irving.

Bisbee, Arizona, December 12, 1917.

The first unit of the cyanamid plant for the fixation of atmospheric nitrogen is nearing completion at Sheffield, Alabama. The plant is being erected as a result of close co-operation between the Ordnance Bureau of the War Department and the American Cyanimid Co., as a war-emergency measure. The plant is to be operated by the commercial organization, but is probably being financed by the United States government. It will be the largest works of the kind in the world.—'Oil Paint & Drug Reporter.'

The Story of the U. V. X. Bonanza—II

By T. A. RICKARD

Now comes the question, how much of this was mere luck and how much of it was due to inductive reasoning from good evidence? When one hears of a great mineral discovery one naturally asks whether luck or science was chiefly responsible. If it was luck, nothing much is to be learned; if science, then the evidence in the case may prove useful to other explorers. In order to obtain an answer to this question, I made a study—such as a journalist-engineer could make in two or three days—of the mine and its geologic environs. In making this inquiry I was aided by Mr. Douglas, to whose hospitality, mental and physical, I am greatly indebted.



CROSS-SECTION OF THE JEROME DISTRICT. THE IRRUPTIVE ROCKS ARE INDICATED WITHOUT ATTEMPT AT PRECISION

The geologic structure of the Verde district may be outlined as follows: The basal rock is a schist, correlated with the Yavapai formation of the Bradshaw quadrangle. This schist is geologically ancient, probably of pre-Cambrian age. It is composed of metamorphosed volcanic tuffs and flows, together with clastic sediments, which in the Jerome district are both argillaceous and silicious. Into these consolidated oceanic sediments a batholith, or mass of intrusive igneous rock, was pushed. The batholith was granite; from it tongues and dikes penetrated the sediments, which, by metamorphism, became schist. The marginal phase of the granite was diorite; this intruded into the schist so freely as to constitute a large proportion of its bulk. By metamorphism the schist became partly crystalline and by shearing the diorite became schistose, so that today it is difficult to distinguish between them. The formation may be called a diorite-schist. Into this rock there penetrated copper-bearing solutions, forming lenses of copper-pyrite at the contact of the schist and diorite. Thus the original copper ore was of pre-Paleozoic origin. Geologically the U. V. X. mineralization is of remarkable antiquity. On the basement complex, after it had been eroded by weathering, there was deposited, in late Cambrian time, the sediment that now appears as beds of sandstone, and later still, probably in the Carboniferous period, a greater thickness of limestone. This series of rocks underwent the movements incidental to the adjustment of the earth's crust to its cooling and shrinking interior. Breaks were followed by intrusions of magma from underneath, forming more dikes and tongues of igneous rock. The substance of these was the felsite* and quartz-porphyry now exposed at the surface or underground. Where these dikes cut through the orebodies they have been kaolinized and bleached, and are known locally as 'watercourses.' Erosion modified the surface successively between these periods of sedimentation and vulcanism. Upon the series of unaltered sedi-

*This may be andesite; I use 'felsite' provisionally.

ments that covered the earlier complex there overflowed, in Tertiary time, from a volcanic vent, a lava of the kind known in Arizona as 'malapai,' a word derived from the Spanish *mal pais,* meaning 'bad land.' This is a rock of the basalt type.

On referring to the U. S. Geological Survey's folio on the Bradshaw Mountains, published in 1905 and devoted to a preliminary description of the region, I find that the authors, T. A. Jaggar and Charles Palache, state that diorite "forms the west wall of the United Verde orebody." This diorite they describe as "a basic border phase of the Bradshaw granite and is found chiefly on the borders of large masses of that rock along its contact with the Yavapai schist," where the granite has intruded into the schist. The sandstone and limestone at Jerome are said to be "outliers of the great mass of horizontal Paleozoic and Mesozoic sediments that form the high-plateau region of northern Arizona and New Mexico."

The ore was precipitated from solutions following in the wake of deep-seated intrusives. Copper wes deposited in fractures and in the crushed rock adjoining fractures or between them, and by substitution of the more soluble portion of the schist formation. The earlier mineralization was associated with the intrusion of the diorite, before the deposition of the sandstone and limestone. The main fact is that the ore is in the schist near the contact with the older intruding igneous rocks, but equally important is the belief, so fully confirmed by evidence as to have the value of a fact, that the rich orebodies of the United Verde and U. V. X. mines do not represent the mineral as deposited primarily, but they are enrichments of the original copper mineral through the addition of the copper brought down by percolation from above.* The primary mineral is chalcopyrite, the secondary is chalcocite. As the surface of the copper-bearing schist was weathered and eroded, the copper was dissolved by the ground-water and carried downward, to be re-precipitated as chalcocite, which covered and eventually replaced the chalcopyrite. This process of migration and concentration was not confined to a short space of time nor to a single geologic period; it began soon after the primary ore was deposited, but the product now removed by the miner is the result of actions and reactions that have been at work from remote ages until today.

It will be understood therefore that as this ore was formed in the diorite-schist, under the thick covering of younger rocks, there would have been no evidence available to the miner if these overlying rocks had not been removed by erosion, so as to expose the deep-seated ore-bearing formation. This exposure was brought about by faulting. See Fig. 4.

In the U. V. X. mine, as we have seen, the schist and diorite are covered by 500 ft. of sandstone and limestone, and these in turn by a cap, 200 ft. thick, of lava. No sign of the rich orebodies exists at surface. Walking up the steep hillside the miner finds that the basaltic lava, or 'malapai,' ends abruptly; above a line, or band, of crushed rock running athwart the slope there appears the schist that contains the rich orebodies of the United Verde mine. Higher on the hillside there is a succession of sandstone, limestone, and lava—like the section exposed by the U. V. X. workings. The break between the upper and lower series, where the recent lava is now in contact with the old schist, marks the course of a fault. The town of Jerome is distributed along this fault, because the scarp of it furnished footing for buildings. For two miles the course of this fault is N 37°W, for five miles it is N 53°W, but the strike varies widely, between due north and N 60°W. It is a corrugated surface, not a simple plane of movement. The dip of it is about 65° north-eastward near the Daisy shaft. It runs south-eastward from below the United Verde slag-dump, under the town, underneath the post-office, passing close to Miller's store, above the lower school-house, and nearly under the two upper school-houses; thence it drops into Deception gulch, where the shaft of the Calumet & Jerome mine is almost in it, but just above it. The vertical displacement produced by this dislocation of the earth's surface is 1700 ft. and the horizontal displacement is 900 ft. down-hill, that is, north-eastward. If restored to its former position the main orebody in the U. V. X. would be underneath the post-office of Jerome. Now it will be evident why the U. V. X. orebodies remained so long undiscovered. There was no sign of them at surface, there was no proof of a continuity of the United Verde orebodies into outside ground, and Senator Clark took pains to prevent others from obtaining any such information as would have encouraged systematic search.

On May 21, 1917, Mr. Douglas took me underground in the U. V. X. mine. In the 800-ft.[7] station of the Edith shaft the sandstone appears, but 300 ft. southward and 200 ft. westward the drifts penetrate diorite. This rock has a schistose structure and is not easy to distinguish from the true schist, which has been so metamorphosed as to resemble a diorite. Together these two rocks constitute the country-rock of the ore-zone. The principal orebodies appear to be adjacent to, and replacing, a series of later dikes, now much kaolinized and devitrified into felsite. Mineralization is intensive where this felsite traverses the contact of quartz-porphyry and diorite on the north side of the ore-zone; in short, the ore is found in a complex of eruptives the true relations of which can be determined only by aid of close microscopic study. I

*S. F. Emmons, in 'The Secondary Enrichment of Ore Deposits,' Vol. XXX, p. 192, Trans. A. I. M. E., speaking of the United Verde mine, said: "The physical conditions there more nearly resemble those of Butte than at either of the other localities [Bisbee, Globe, and Clifton-Morenci], and an underground study would probably have been most instructive. Unfortunately, the policy of the exclusion of visitors pursued by the owner was strictly enforced in my case, and I could only determine that rich sulphides do occur beneath the gossan."

[7]It must be remembered that the depth of the levels is taken from the old Daisy shaft, the collar of which is 154 ft. higher than that of the Edith shaft.

am informed by Horace V. Winchell that much of the supposed quartz-porphyry is only quartz. Mr. Winchell makes the illuminating suggestion that the jasperoid quartz covering the orebodies and common elsewhere in the pre-Cambrian rocks is not a 'cap' nor a leached gossan, but a part of the original country-rock, in this respect resembling the jasper of the Keewatin series in the Lake Superior district. This quartz, he believes, is not veinstone but a silicious oceanic precipitate produced in pre-Paleozoic time.

The conditions at Jerome are by no means unusual; on the contrary, our experience of mining all goes to show that there is no more favorable place for the deposition of ore than where schist has been fractured and penetrated by eruptives followed by thermal waters. Rio Tinto is an old example; Miami is a later one. This fact has been linked, in hypothesis, with the big fault, but it is important to note that the fault cuts the basalt and therefore is post-Tertiary.† A tunnel on the Hermit claim, I am informed, cuts the fault and exposes the relationship just cited. Along the system of fractures the mineralizing solutions were enabled to circulate and deposit their content of copper. The trend of the U. V. X. ore-bodies is S 70° E in a mineralized zone about 1000 ft. wide. The ore within this zone follows no uniform direction, the strike and the shape being irregular, as modified by a network of fractures and dikes. The big fault has not been cut near the main orebody; it ought to be about 170 ft. south-west of it; it is probably steeper than generally supposed. As seen in the Daisy workings the fault appears as a confused mass—40 to 100 ft. thick—of crushed rock, consisting of mud and fragments, torn from the strata through which it has passed.

The main orebody is bounded on the east and south by a kaolinized selvage; this shows native copper in leaf



JEROME, ARIZONA

1 Level beds of limestone. 14. Diorite-schist. 13. Basalt. 16. Limestone. 4 to 9. Bitter creek. 11. Columbia mine, of the Jerome Verde Co. 10. Ruins of Colonel Bosworth's smelter. 3. United Verde mine. 6. United Verde Extension. 4. Little Daisy shaft. 0, 6, 7, 8. Line of the big fault. 6 to 7. The town of Jerome. 15. United Verde slag-dump. 2. Railway station. 12. Mt. Cleopatra.

form near the smaller orebody at 1407. East of the main orebody the kaolinized rock includes several inches of chalcocite and on the west this vein of chalcocite separates the 'felsite' from 'quartz-porphyry.' Only microscopic investigation can furnish data for a correct labeling of these rocks.

If one may be permitted to theorize on such slender evidence, I would say that the youngest kaolinized dike-rock was the chief agent in producing the concentration of copper mineral that we call 'rich' ore. The diorite is ore-bearing where crossed by this 'felsite,' particularly where the 'quartz-porphyry' contacts provided facilities for fracture. Such fracturing was intensified near the line of the big fault. Thus conditions favorable to ore-deposition were localized. The diorite-schist is pene-

†Although the fault may cross the basalt, it is possible that this is merely an extension, due to renewal of movement in Tertiary time, of a rupture caused and a line of fracture established at a much earlier geologic period.

trated by veins of quartz and iron-stained shear-lines. Along some of these copper is to be seen in oxidized condition, as carbonate. That brings me to the evidence that induced Mr. Douglas to spend a large sum of money in search for ore.

Mr. Douglas was attracted, in the first place, by the iron-stained vesicular ('vuggy') quartz at the south end of the Fisher drift, on the hanging-wall side of the fault in the Daisy workings. Similar signs of ore were noticed by him in the north-easterly cross-cut, which for 270 ft. runs through decomposed iron-stained schist showing coppery stains along the planes of schistosity. Again, he was impressed by the patch of chalcocite ore cut in a raise at a point 100 ft. above the 800-ft. level. This also lay on the hanging-wall side of the fault, that is, on the side where he expected to prospect. The ore had been dug out, so that none of it was to be seen in place, but some of it remained on the dump, and he believed the statement concerning it to be true. He had a good general idea of the local geology and of the structural conditions produced by the fault.

As I stood on the ridge between Mr. Douglas's house and the Edith shaft, I looked up the ugly hillside toward the United Verde mine and asked myself whether, having seen the evidence described to me by Mr. Douglas, I would have been inclined to spend my own money and my friends' in a costly search for a bonanza. Frankly, I have too little of the speculative temperament to have started the project in the big way in which Mr. Douglas carried it through, but if I had been engaged to advise a rich man in the matter, I would have told him to go ahead. Let me describe what an observant miner sees from the spot I have indicated: On the crest of the hill due west, above the Daisy shaft and behind the United Verde buildings, the level line of the white limestone makes an escarpment. The sandstone appears under the limestone, as can be ascertained by closer inspection. Just above the United Verde shaft-house one sees a big open-cut, or 'glory-hole,' in the diorite-schist underneath the sedimentary rocks. The slag-dump cuts across the hollow in which Bitter creek has its source. The fault is suggested by the break between the diorite-schist and the near ridge of malapai. Even an amateur geologist can follow the line of crushed rock marking the fault, which runs through a gap between the malapai ridge of Main Top hill and the higher slope on which the United Verde slag-dump rests. The fault crosses the hillside just above the Daisy shaft and under the stable on the left, south-eastward toward the town of Jerome. The bed of Bitter creek is a gully full of the detritus of the rocks above, washed from the outcrop of the fault. The malapai in front and to the right on Main Top hill has been eroded to a thin edge on the near or eastern slope, exposing the limestone underneath. Below the limestone the sandstone appears, and following the slope toward the Verde valley a series of horizontal limestone beds is uncovered, suggesting block-faulting.

The relation of the beds of limestone and sandstone near-by to that of the similar series on the top of the hill, with a pronounced line of crushing and movement between, is a plain indication of a fault. Above the fault there had been found copper ore of extraordinary richness and in large masses; why then should not similar ore be found on the lower or hanging-wall side of this fault? That seems an obvious question. Fisher answered it affirmatively and proved the courage of his conviction by starting to prospect in the Little Daisy ground. When Douglas took hold of the venture he could see what Fisher had seen on the surface, he understood the effect of the fault in dropping the ore-bearing zone, and he had the further evidence furnished by the patch of chalcocite that Fisher had found in the Daisy workings. Small as it was, it sufficed to prove that the ore-making or copper-concentrating process had been at work below the fault. This evidence of secondary enrichment was highly important. Moreover the fault had been cut in the Verde adit[8] (called the Hopewell tunnel). It seems to me that on that evidence a group of rich men could afford to risk $225,000 in searching for ore. The ante was not too big for the game.

I have not included the oxidized copper among the favorable signs. It had no immediate bearing on the problem. Such copper stains and patches of carbonate ore were mere *humo de cobre,* as Mr. Douglas, out of his familiarity with mining on the Mexican border, calls them. They were quite different from the *hilos de calcocita,* or threads of chalcocite, that indicate secondary enrichment. Such oxidized copper has been precipitated probably from the water draining down-hill from the outcrop on the United Verde ground, coming down Bitter creek and seeping into the lower ground. On the other hand, the silicified rock poor in copper, but still stained by it, might represent the upper portion of an orebody the copper from which has been leached for the benefit of the bonanzas in the deeper zone. It is probable, however, that such a conventional explanation would be wrong. The copper stains are exogenous not endogenous, as Posepny would have phrased it; they came from outside and are not remnants of copper the rest of which has been removed by leaching. It is likely that seepage from above explains the presence of the precious metals in the copper ore. In the Copper Chief mine, on the outskirts of the Jerome district, an enrichment with gold and silver is traceable to the overlying limestone. It is probable, as Mr. Winchell suggested to me, that carbonated waters from the limestone brought gold and silver into the gossan formed by the weathering of the masses of copper ore in the United Verde, but not in the U. V. X. mine, since the latter was enriched for the most part in pre-Cambrian time, before the limestone was laid down.

The bonanzas are now three or four hundred feet below the former surface of the schist. They were formed by the enrichment and alteration of the quartz, pyrite, and chalcopyrite of the primary ore. Where oxidized they show residual limonite and appear like the vesicular copper-stained quartz on the 800-ft. level of the Daisy

[8]Through which the ore of the United Verde passes on its way to the smelter at Clarkdale in the Verde valley.

workings. The erosion of the fault-escarpment, containing broken fragments of ore, would cause copper to be dissolved in the water of Bitter creek. On the upper side of the fault a large tract of Cambrian land-surface has been eroded, removing part of the ore-zone, and some of the copper that was in it may have been washed downward to enrich the other and intact part of the ore-zone that was preserved under the sedimentaries and under the cap of lava. Whether mineralizing solutions from the schist followed fractures into the overlying limestone, and there formed orebodies by replacement, is a nice question. Some of the ore found, for example in the Dundee & Arizona mine, may be of this character, but as orebody must have occupied a position underneath the post-office in Jerome, and the main orebody must have lain still farther from the United Verde. The orebodies in the two mines are not projections of each other; they are connected not on the dip but on the strike of the ore-channel, which does not coincide with the fault. There was a connection of mineralized ground along the strike in this ore-channel, and it was disrupted diagonally by the fault. The fault itself dips more flatly than the ore-channel and they should intersect in the U. V. X. ground at a depth of about 2000 ft. That disposes of the possibility of apex litigation.

The heavily sulphurous character of the ore presents



THE U. V. X. SHAFTS, LOOKING EASTWARD, SHOWING THE EDGE OF THE DARK COVERING OF BASALT ON THE WHITE LIMESTONE

to that I do not know. When copper has been found, whether as carbonate or sulphide, in a given spot, it is not possible off-hand to say whether it was precipitated by ascending or descending waters, but the answer to such a question can be made after careful investigation, and it furnishes information of immediately practical value to the prospector. In the United Verde both chalcopyrite and bornite are found down to 1800 ft., that is, far below the chalcocite zone of secondary enrichment, which has yielded bonanza stopes for a vertical depth of 800 feet.

Next comes the question of the connection between the United Verde and the U. V. X. orebodies. In the first place, the latter is not a part of the former, that is, if the ground were restored to its former position, as it was before the faulting, the U. V. X. orebodies would not connect with those of the United Verde. Originally the U. V. X. ore was higher than that of the United Verde. Before the ground was faulted the smaller (or 1407)

a danger against which the management of the U. V. X. mine must guard systematically. A forcible reminder exists already. In approaching the 1407 stopes, in the smaller orebody first discovered, the temperature rises rapidly to 103° F. Farther it is not safe to go, the heat and gas being dangerous. Iron wire, broken car-wheels, and other scrap have been thrown into the ditch alongside the track, so that the water issuing from the burning ore may precipitate its copper. After passing over this scrap-iron the water is neutralized by the addition of lime carbonate so as to destroy the acidity, which otherwise would corrode the pump-line. Combustion has been started by caving. The stope was carried five sets above the level, the ground being held by square sets filled with waste, except at the working end, which was two sets wide and two sets high, not filled. A round of holes was shot in ore at 11.30 one morning and indications of caving were visible when the men returned to work after the noon interval. The men were withdrawn immediately

and at 3 p.m. the whole east side and the back of the stope collapsed, crushing the timbers all the way down to the sill-floor, the height of five sets, or 41 ft. The rise in temperature became sensible in a few days. The cave started four sets above the 1300-ft. level and dropped the ground 8 ft. This was enough to develop sufficient friction to cause combustion in an ore containing 28% sulphur, according to reactions utilized in converting matte where there is iron sulphide that is readily oxidizable in association with copper sulphide. The misfortune was hastened by the fact that the rich copper ore dipped at an angle of 60° and had an overburden of crumbly pyrite. The block of ground 'on fire,' that is, in a state of smothered combustion, contains 2000 tons of 30% ore.

The neighboring United Verde mine has suffered severely from this cause. The first fire, in 1894, was due, as in the case just cited, to spontaneous combustion following a cave. As it could not be extinguished, the place first affected was bulkheaded so as to prevent a spreading of the fire, but even this was not done completely, therefore "the smoke and gas worked its way over the orebody on the different levels and cut off a large productive area of high-grade ore," as Robert E. Tally, the superintendent has related.[9] Two other fires started, doing great injury to the mine. An attempt was made to extinguish the combustion by flooding with water, but this failed, the air inevitably finding its way to the burning ore. Then carbon di-oxide gas and steam were tried, in turn, but in vain. It was found impossible to shut off the parts affected so as to apply these remedies effectively. In 1905 the plenum system was introduced. This consists in forcing air against the gas generated by the combustion; an air-pressure of 2 to 5 lb. suffices to keep back the gas and cool the ground sufficiently to render mining possible. Mr. Tally states that by this method the temperature was reduced from 1200° F. to 120° F. in about six weeks. Gradually, by ventilation, the temperature was lowered to 75°. The air forced into the hot stopes now finds an outlet through raises in the foot-wall direct to the surface, so that the gas does not penetrate the upper workings. The current of air is regulated by doors connecting with the stopes at successive levels.

To extinguish a mine-fire is satisfactory; but to prevent one from starting is better. The mass of low-grade pyrite on the hanging-wall side of the rich ore at 1407 was so loose as to run like sand; it was separated from the chalcocite by two feet of soft decomposed rock, so that the conditions were peculiarly treacherous. Exactly similar conditions may not be repeated elsewhere in the mine, but something like them has to be faced in other parts. The ore-ground is exceedingly 'heavy,' in the miner's sense, as it is also in terms of specific gravity. Seven cubic feet of ore weighs a ton. The chalcocite breaks in slabs; it is brittle; it breaks readily; in stoping, a few 'pop shots' suffice. To prevent 'runs,' the ore has to be bulkheaded continually.

[9]Robert E. Tally. 'Mine-Fire Methods Employed by the United Verde Copper Co.' Trans. A. I. M. E., Vol. LV, pp. 186-200.

Mr. Douglas and Mr. Kingdon are fully alive to the perils of fire in ore of this character. To safeguard the mine it is proposed to make barriers across the big orebody. A cut 12½ ft. wide will be carried through the ore; this will then be filled with waste from the surface. Any waste used for filling should contain less than 3% of sulphur. Thus a fire-proof barrier will be formed. Other barriers will follow at 25-ft. intervals. The cost of any such protective method is unimportant in such rich ore as compared with safety and completeness of extraction. The ore is so rich that it must be removed cleanly.

Good ventilation is another prime requisite; therefore the Daisy shaft is used as an upcast, so that fresh air comes down the two working-shafts. The new, or Concrete, shaft is 250 ft. east of the Edith; it was sunk only 170 ft., the rest being done by raising from the different levels. An ore-pocket to hold 1000 tons of each of the two classes of ore is to be made between the 1100 and 1300-ft. levels; this pocket will discharge into 30-ton cars driven by an electric-storage motor through an adit, 11,200 ft. long, which enters on the 1300-ft. level. The mouth of the adit is 4¼ miles from the smelter, to which the ore will be delivered on a 1.7% grade and 4° curves. The smelter, designed by A. G. McGregor, will have a capacity of 1000 tons of ore and is to be finished in 1918. Then the U. V. X. mine will be equipped for steady production.

Manganese in Arkansas

The high prices for manganese ores have stimulated interest in the little-exploited manganese deposits of west-central Arkansas. These deposits are found at intervals in a belt 4 to 12 miles wide, which extends west-southwest from Pulaski county, at the centre of the State, to Polk county, on its western border. The deposits have been worked only in a small way and have produced but a few hundred tons of marketed ore. The ores consist of the four oxides, psilomelane, pyrolusite, manganite, and wad, the first three forming the larger part of the ores. Although these minerals may be found separately, two or more are generally intimately mixed in the same deposit, and at some places they are associated with iron oxides and manganiferous iron ores. The manganese ores occur as nodules, pockets, and short irregular veins from a fraction of an inch to 4 ft. thick, though veins 4 ft. thick are rare. The orebodies are scattered through the hard Arkansas novaculite and can doubtless be found on every mountain where the novaculite is exposed. They occupy bedding planes or joint cracks, or form a cement in a novaculite breccia in which the rock fragments range in diameter from a fraction of an inch to over a foot. Most of the ores contain too much phosphorus for use in the manufacture of ferro-manganese, and too much iron for use in chemical industries and electric batteries, and where the quality is suitable for these purposes the quantity is generally too small for profitable mining.

Hoisting-Ropes

By M. H. SIGAFOOS

*Until recent years it was generally conceded that the foreign steels for the manufacture of wire-rope were by far the best, due principally to the fact that Swedish ores, considered the finest the world affords, are employed as their basic foundation. Such foreign steel as is imported by the American manufacturer for wire-rope purposes, is made to meet rigid specifications, insuring as nearly as possible a uniform quality, and is carefully tested and analyzed to insure correct percentages of manganese, silicon, and carbon, as well as the great necessity of their being extremely low in sulphur and phosphorus. Both of the latter elements are detrimental to the production of wire to be used in the manufacture of wire-ropes. Acid open-hearth steels are admitted to be better than basic open-hearth and it has been suggested that this is due to the higher oxygen content in the basic steel. Much has been claimed for the qualities of chemically treated steels, such as vanadium, chromium, and others, and in many instances they have proved the claims made for them, but for use in wire-rope they are still in the experimental stages, and no data are available at this time.

Wire made from steels intended for the manufacture of wire-rope for ordinary purposes is divided into three classes, namely: Iron, with a breaking-strain of approximately 80,000 lb. per sq. in.; cast-steel, often erroneously called crucible-cast, which has a breaking-strain of 170,000 to 180,000 lb. per sq. in.; and plough-steel, with a breaking-strain of 200,000 to 250,000 lb. per sq. in. Wire is often drawn to a considerably higher tonnage, but this is rarely used for any other purpose than for standing-rigging on racing-yachts, where maximum strength, with the lightest possible weight, is essential, such wires are sometimes drawn to 260,000 lb. per sq. in. Very small sizes of wire-rope or strands for aeroplane-guys are drawn to even a higher tonnage.

There has been much discussion on the point as to when a wire-rope has reached the end of its usefulness, and when it should be removed. Up to the present time it seems the question remains unanswered.

After an exhaustive investigation of the bending and load-stress, conducted by the Bureau of Standards, a report was published, as Bulletin No. 75, stating in substance, that a rope should be removed after a certain number of broken wires appear in each of the strands. The tables in the report undoubtedly have been compiled from stated loads, speeds, head-sheaves, and drum-diameters; from shafts of various depths, and, taking into consideration the torsional and load-stresses, they form a useful guide. However, as there is no standard of sheave and drum-diameters, except those recommended by rope manufacturers, nor any set rule for maximum loads, it is evident that with each variation in the diameter of sheaves or load, so will the bending-stress and the load-stress vary. Both of these stresses are of great importance and have a direct bearing on the factor of safety. In the catalogues of the wire-rope manufacturers are to be found the 'proper working-loads' of wire-ropes for the given sizes and grades. This, in almost all cases, is approximately 20%, or about one-fifth of the appromixate breaking-strength of the rope, and would appear to be a factor of safety of five. This, however, is not the case, as will be shown, and it is important, in calculating the proper rope for a certain load with a required factor of safety, that this proper working-load should not be confused with the actual factor of safety. While the working-loads do not show approximately one-fifth of the breaking strength of the ropes, it does not by any means indicate that in operation the rope selected would have a factor of safety of five, due to the fact that in addition to the working-load, there are other stresses to be considered, the most important of which is the stress due to bending over the sheaves and drums.

If the rope to be used is operated over standard-size sheaves and drums, the general average of bending-stress equals about 10% of the approximate breaking-strength of the rope. For instance, in a cast-steel wire-rope 1 in. diam., composed of 6 strands and 19 wires to the strand, the approximate breaking strength of which is 30 tons, showing a proper working-load of one-fifth, or six tons, to be used on a minimum size sheave or drum of four feet, the bending-stress would be 2.70 tons, or nearly 9⅓%, of the approximate breaking-strength of the rope. It is thus evident, that, by adding this 9⅓% to the load-stress, which is 20%, we have utilized 29⅓ of the ultimate, and instead of an apparent factor of safety of five, we actually have only 3.41, or less than 3½. This is still further reduced by the stress due to starting the load.

It is often impracticable to utilize the size of sheave or drum recommended by the manufacturer. In such cases the bending-stress will vary inversely as those diameters are greater or less. Assuming, in the above example, that two-foot diameter sheaves were used, the bending-stress would be 5.58 tons, or about 18⅔% of the breaking-strain; this, in addition to the working load, would be 38⅔% of the ultimate strength of the rope, reducing the factor of safety to 2.6. The total working-stress then would be greater than one-third of the ultimate breaking-strength of the rope when new and is not

*Abstract of paper read before the Mining Section of the National Safety Council.

considered good engineering practice. If sheaves twice the diameter of those recommended by the manufacturers, or 96 in., were used, the bending-stress would be only 1.4 tons or about 4¼% of the ultimate strength of the rope. By reducing the bending-stress to a minimum more economical service could be obtained, and in many cases a smaller diameter of rope could be applied, thereby increasing the efficiency of the rope, and promoting a saving in first cost.

Reverse-bends play an important part in the early let-down of a wire-rope. The underwind rope, in which there are reverse-bends, will invariably give a shorter service than the overwind rope. The difference in service of the two ropes varies, but from experience the overwind rope will give 10 to 25% more service. The underwind rope, as it comes off the head-sheave, has taken somewhat of a set, the permanence of which depends on the relation of the rope-diameter to the sheave-diameter; the smaller the sheave the greater the set. The rope now travels to the take-up drum, some distance away, and will wind in the opposite direction to that in which it came off the head-sheave; thus a reverse-bend is thrown into the rope, and, consequently, into the wires themselves. The rope cannot recover itself in most cases, for the set it received by the head-sheave is not entirely overcome before it strikes the take-up drum and consequently the effect of the latter bend is more severe.

Another cause for failure of wire-ropes can be attributed to repeated shocks. The effect of these overstrains, as they may be called, is shown by microscopic examination of the metal as leading to crystallization with a consequent embrittlement of the steel. The overlapping of the rope on the hoisting-drum, with occasional slipping of the top layer into the grooves made by the layer underneath, will, first, cause jerks which increase the load on the rope by an amount depending upon the slack between the drum and head-sheave, and, second, the inner series of wires will crush somewhat from the squeezing between the top and bottom layer and will assume a pear or bell-shape.

In this condition it is impossible for the inner wires to perform their proper function, and the outer wires will be forced to take more than their share of the stresses. They will assume the shape of their cushion, the inner series, causing trouble in the form of abrasion on themselves. Overlapping cannot be eliminated in most cases on account of the amount of rope that must be taken on the drum, but the point to emphasize is the fact that frequent inspection must be made in order to minimize accidents.

There are several methods of fastening ropes to the load, either by means of sockets or clips. Both of these can be made in such a manner as to break the rope before the connection gives out. In using sockets it was formerly thought necessary to turn in or bend back the strands or wires into the basket of the socket. This method is now replaced by opening the wires in the strand of the rope that is to be socketed, thoroughly cleaning them with muriatic acid cut down with zinc, and pouring molten spelter on the straight wires. Tests of this method of socketing have proved that a more uniform strain on each individual wire can be depended upon. It necessitates great care and there is no possible means of inspection. The connection made with clips, if properly applied, is equally strong, and careful inspection can always be made. This connection should be made with the U-bolt section of the clip over the short end of the rope. This insures greater safety, as there is no indentation on the main section of the rope by the U-bolt.

Uses of Nitre-Cake

Nitre-cake is the product resulting from the reaction between sodium nitrate and sulphuric acid in the nitre-pots at sulphuric-acid works. These chemicals when combined and subjected to the heat of the sulphurous gases from either the pyrite or the sulphur-burners, evolves the nitrous fume necessary for the oxidation of the SO_2 in the gases to SO_3. The resultant liquor in the nitre-pots, on being discharged into the air, solidifies and is then called nitre-cake. Theoretically it should be acid sodium sulphate ($NaHSO_4$), but actually it generally contains about 78% of that salt with 18% of Na_2SO_4, and about 4% moisture. As an acid reagent it is equivalent to about 32% sulphuric acid, and the saturated solution corresponds approximately to 18% H_2SO_4. The acid sodium sulphate, which is a waste-product from the manufacture of sulphuric acid, can be used as a substi tute for that material in many industries, and thereby help to economize on this commodity, so essential in the making of munitions, fertilizers, and a thousand other necessaries of modern civilization. Indeed, the acid sodium sulphate, which can now be had at many places for the cost of hauling it away, may be used directly in compost-heaps with raw ground phosphate rock, thereby converting it to soluble phosphate and leaving a sulphate of soda that is in itself beneficial as a fertilizer on many soils; it is valuable also for removing oxide and scale from articles of iron or steel, such as castings, forgings, pipe, bolts, nuts, and rivets, and from sheet-metal for galvanizing; it is useful as an acid wash, as a cream of tartar substitute for baking powder, as a bleaching agent in paper manufacture, for the production of hydrochloric acid by reaction with common salt; and for a large number of other purposes. It is the most practical substitute for sulphuric acid that is available, and its utilization is a matter of national concern.

NORTH CAROLINA, at the present time, produces about 1300 oz. gold and 700 oz. silver per annum. Copper to the extent of about 10,000 lb. is produced from Granville and Rowan counties. The possibilities of the State are much greater but development is retarded in part by difficulties over land-titles and still more by an exaggerated idea among the people as to the value of undeveloped mineral land.



AHMEEK STAMP-MILL



CALUMET SHAFT NO. 5

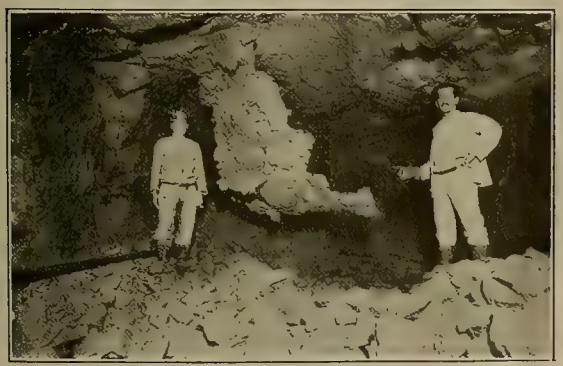
The Lake Superior Copper Country

By HOMER GUCK

The development of copper mining in the United States is as synonymous with the operation of the Calumet & Hecla as it is with the expansion of electricity. How the great Calumet conglomerate lode was discovered is still a matter of dispute. People in Michigan continue to believe that 53 years ago old man Royale's boarding-house pig stuck his snoot into the Indian pit in the back yard of his road-house and unearthed a cache of copper. That was the story as told by E. J. Hulbert, the discoverer.

The fact remains that the discovery of the great conglomerate was due to mere chance. Hulbert was surveying a state road from Copper Harbor, the most northern point in the State of Michigan, to the south-west limit of what is now Houghton county. Royale's boarding-house was on the site of the Miscowaubik Club. It was a halt for overland passengers from Houghton to Eagle River, then the two larger towns. Centuries before, the Indians, having dug their mass copper from Isle Royale, started south for the winter. Desiring to avoid Keweenaw point, they went overland through the peninsula and were caught by an early winter. They dug a pit and buried their copper. Their pit happened to be right on the hanging wall of the conglomerate lode of the Calumet & Hecla and the present location of No. 1 shaft, Calumet mine, still in operation. The surmise is that George Agassiz, son of the late Alexander Agassiz, for many years the president and directing head of the property. The Indians never returned for their copper.

In the 17th century French explorers found copper on the Ontonagon river. This district was a virgin forest 73 years ago when the Chippeway Indians ceded it to the United States. Twenty years before the Civil War there was a copper boom, which subsided and left a few small mines in the forests then covering this part of Michigan. The search then was for mass and boulder



A MASS OF NATIVE COPPER



A MACHINE-DRILL AT WORK

copper. It was in 1858 that Hulbert made his discovery. At first he thought he had an old Indian mine. In examining the surface he found the conglomerate outcrop just south of the cache at what is now No. 1 Hecla shaft. This big block of conglomerate was wonderfully rich. Hulbert was unable to buy the tract at Hecla, but, keeping his discovery quiet, secured the Calumet property. He sank his first shaft at what now is No. 4 Calumet, and in the middle of September 1864 opened the conglomerate. Later he associated himself with Quincy A. Shaw of Boston. That gentleman furnished the funds by which the property was secured from the St. Mary's Mineral Land Company.

At the time of the Civil War the production of copper in the world was insignificant, the Rio Tinto mines of Spain producing the largest part of it. The metal sold as high as 52 cents per pound. At that time Michigan was just coming into prominence, the output being confined to so-called 'float' copper and masses found near the surface and handled directly in a smelter. The Quincy mine was then our largest producer. It got out two million pounds in one year. The Calumet & Hecla produces that much in three days now. By the way, the Quincy has paid dividends to its shareholders continuously from that time to this, missing just one year, during the Western Federation strike in 1913.

With the discovery of the Calumet conglomerate the whole system of getting out copper changed. In this district the conglomerate carries the copper in its pure state in particles from as small as a pin-point to the size of a fist. The Calumet conglomerate lode has paid at least $150,000,000 in dividends to the shareholders of the Calumet & Hecla Corporation, and over $300,000,000 in wages to thousands of employees and indirectly for maintenance and operation. In the early days the Calumet & Hecla ore was very rich. Each year it is becoming leaner. Some idea of the industrial problems this corporation has met and overcome may be gained from a brief explanation of the operation. First you sink your shaft, equip your plant, build your stamp-mill and smelters. All these things cost millions. But forget them. They are up and operating. Now to get copper out of the ground the miners go down a mile from the surface, then as much as half a mile from where they left the skip to the place where they operate a drill for six hours, punching holes into the copper-bearing rock. The holes are filled with powder and the ore blasted down. This ore, locally called 'rock,' is put into cars, pushed to the shaft, and dumped into the hoisting-car, or skip, to be hauled a mile to surface. At the top of the shaft the skip is dumped again and the ore goes through a series of crushing processes in the shaft-house itself, after which it is fed into cars to be hauled five or six miles to the stamp-mill, where it is dumped again, crushed into small pieces by stamp-heads having a pressure of five tons, jigged and crushed and rolled and washed on innumerable tables, re-ground again, and finally put through an acid and flotation process to prevent the escape of the smallest particles of copper. Then the concentrate of native copper is hauled another mile from the mill to the smelter, where it is roasted, treated by electrolysis, and cast into cakes or bars or slabs, as the customer requires. Most of it is shipped to New York. For every ton of ore that is blasted down in the mine—for every 2000 pounds—there is extracted just 20 pounds, or 1%, of copper. The remainder, 1980 lb., goes into the lake.

To the reader of this technical magazine these statements sound like the elementary instruction of a mining college. I am telling it just as I do to every committee from the southern farming or city district of the lower peninsula of Michigan when they come to visit us and want to see a mine. They have no conception whatever of the enormity of the problem that takes a speck of copper from a point a mile or two from surface and puts it down on the New York dock at a profit; and too often our high-grade technical engineer passes over these details without a thought, giving no consideration to the things that are so obvious to him, accomplishments in which he himself has taken a part; accomplishments that are so much a matter of reality that he fails to appreciate their importance because of their familiarity.

A year ago all this was done at a cost of ten cents per pound. Now the cost is higher, probably 13 cents. That is due to the rise in wages and the increased cost of everything that is used in the operations. The Calumet & Hecla for itself and ten subsidiaries, employing 14,000 men, has just announced a continuation of the 10% bonus and the 5 cents per diem increase in pay for another six months.

In the early days richer ore closer to surface was worked. Then the miner got 100 pounds from every ton, and lost 30 lb. in the stamp-mill, and thought nothing of it. Now this old tailing is being worked over again and it is paying better than a new mine. That fact alone illustrates the metallurgical progress made at this wonderful mine. With the greater depth, with the leaner ore, it has been a man's problem to keep this great corporation up to its standard of earning capacity. And the man who took charge of this property when it seemed to be going the way of all mines was a Michigan product, James MacNaughton, now the first vice-president of the company. Today the total cost of mining and of bringing the ore to the surface through a mile or two of workings is one dollar per ton. And the miners are the best paid workmen in the world. Today their average wage is $5 and many of my miner friends are cashing contract checks that run better than $250 per month.

But the most wonderful thing about the Calumet & Hecla is its paternalism. When we had a strike here a few years ago, the only one in the history of the enterprise that amounted to anything, the cry of too much paternalism was raised. But it failed, as did the last dying effort of the Moyer-Mahoney gang of Western Federation agitators. The paternalism is not ostentatiously displayed, but it is none the less practical and effective. It gives the Calumet & Hecla the finest class of miners to be found anywhere.

Nickel-Copper Steel Direct From Sudbury Ores

By F. H. MASON

*While the component parts vary at different mines and in different parts of the same mine, the massive nickeliferous pyrrhotites of the Sudbury district of Ontario may be said roughly to contain:

Iron	40.0 %
Sulphur	30.0 "
Nickel	3.5 "
Copper	1.2 "
Gold	0.01 oz. per ton
Platinum	0.01 " " "
Silver	0.29 " " "

By the present method of reduction both the iron and sulphur are wholly lost, and when we consider that 70% of the nickel is used for alloying with steel to form nickel-steel, the wastefulness of the process is at once evident. It has long been the dream of the metallurgist to discover a process by which this waste can be avoided. The difficulty in the past has been threefold; first the complete elimination of the sulphur, second the rooted objection of metallurgists to the presence of copper in the resulting steel, and third the loss of the precious metals, which, of necessity, go into the pig, and hence into the steel. The first two of these objections have now been overcome. By improved methods, the sulphur content of the pulverized ore can be reduced to less than 0.5% by roasting in a Wedge furnace, and if, after smelting, the resultant pig is converted into steel in a basic-lined electric furnace the sulphur content of the steel is negligible. It is freely admitted that copper in excess of 0.75% will make steel red-short, for the reason that steel will not dissolve a greater amount, and the copper separates. But recent researches on nickel-copper steel alloys have demonstrated that when both nickel and copper are added to steel, if the ratio of copper to nickel is less than 1:3 the copper does not separate and consequently red-shortness does not ensue. This is readily explained by the fact that nickel is a solvent for both iron and copper and consequently holds the latter in a solid solution in the steel. It has been found, for instance, that 3.5% of monel metal, which contains 69% nickel, 29% copper, and 2% iron, added to steel makes an alloy substantially the same in mechanical and other properties as a 3.5% nickel-steel. The third objection, that of the loss of the precious metals in the pig, has not, and, from the light of our present knowledge, will not be overcome, but the loss is more than offset by the gain of the iron and of the cheaper metallurgical treatment. Besides, the precious metals are now lost in the manufacture of monel metal, and, at any rate in part, by the Orford process of refining, as is proved by their presence in many of the International Nickel Co.'s products.

The first attempt to produce nickel-steel directly from the Sudbury ores was made by E. J. Sjöstedt more than ten years ago, at Sault Ste. Marie, under the auspices of the Canadian Department of Mines. A low-content nickel ore was selected with the view of keeping the nickel content of the pig as low as possible. The roasted ore contains 2.32% nickel, 0.41% copper, 45.8% iron, and 1.56% sulphur. The charge employed consisted of 400 lb. of ore, 105 lb. charcoal, and 40 lb. limestone. This was smelted in an electric furnace, and the resulting pig contained 4.1% nickel, 0.7% copper, 0.006% sulphur, 0.04% phosphorus. In all 14,500 lb. of ore was smelted and 7336 lb. of pig metal was produced. The power consumed was 0.39 hp-yr. per 2000 lb. of pig produced, and the charcoal consumption was 55% of the weight of the metal obtained. Later, under Sjöstedt's direction, 168 tons of nickel-copper pig was produced at the rate of 1.34 tons per day in an electric furnace at Sault Ste. Marie. Some of this was converted into steel in a Heroult furnace at the plant of the Halcomb Steel Co. To reduce the nickel content and make the resulting steel comparable with standard 3.5% nickel-steel, scrap-steel had to be added to the charge. The following are the results of chemical and physical tests of the copper-nickel steel, and for comparisons tests made at the same time of open-hearth nickel-steel:

ANALYSES

	Open-hearth nickel-steel	Copper-nickel steel
	%	%
Nickel	3.36	3.62
Copper	...	0.48
Carbon	0.46	0.44
Manganese	0.70	0.50
Sulphur	0.034	0.013
Phosphorus	0.021	0.013
Silicon	0.066	0.034

TENSILE STRENGTH AS ROLLED

	Open-hearth nickel-steel	Copper-nickel steel
Elastic limit, lb. per sq. in.	74,625	72,400
Tensile strength, lb. per sq. in.	122,000	115,000
Elongation in 2 in., per cent.	16	22
Reduction in area, per cent.	34	51

TENSILE STRENGTH ANNEALED

	Open-hearth nickel-steel	Copper-nickel steel
Elastic limit, lb. per sq. in.	64,750	63,750
Tensile strength, lb. per sq. in.	119,000	107,300
Elongation in 2 in., per cent.	17	25
Reduction in area, per cent.	37.5	48

*Based upon information given in the Report of the Royal Ontario Nickel Commission.

Tensile strength after quenching in oil from 1500° F. and reheating to 800° F.		
Elastic limit, lb. per sq. in.....	1,561,500	154,000
Tensile strength, lb. per sq. in.....	175,000	172,500
Elongation in 2 in., per cent.....	9.75	13.25
Reduction in area, per cent.....	30.8	49.1

These results, it will be seen, are in favor of the nickel-copper steel, for while the tensile strength is slightly less than that of the nickel-steel, the elongation is considerably greater. This may be due in part to the fact that it was made in an electric furnace, while the nickel-steel was made in an open-hearth furnace, but, be that as it may, the nickel-copper steel stands up to the requirements of a 3.5% nickel-steel. Still, notwithstanding the favorable tests, metallurgists refused to accept nickel-copper steel for structural purposes; it was barred in most specifications, and at the time of his death, Sjöstedt was working out a process for the economical removal of the copper prior to smelting the roasted ore.

At the request of the Royal Ontario Nickel Commission, Alfred Stansfield repeated Sjöstedt's experiments on a laboratory scale at McGill University and to a great extent corroborated his results. Mr. Stansfield did not produce as good a steel as that obtained by the Holcomb Steel Co., but, considering that he was working on a laboratory scale with charges that produced only from 14 to 20 lb. per pig, it was hardly to be expected. The following are the physical tests on the steel produced at McGill:

Elastic limit, lb. per sq. in.....	70,100
Yield point, lb. per sq. in.....	77,400
Maximum load, lb. per sq. in.....	101,500
Elongation in 2 in., per cent.....	18
Reduction in area, per cent.....	31.9

Many metallurgists still retain this prejudice against copper in steel, even in the face of the fact that the U. S. Government is using 8-in. shells of monel-metal steel and find that they pierce armor-plate equally as well as nickel-steel of the same percentage alloy.

The most interesting evidence given before the Nickel Commission with regard to the possibility of making nickel-copper steel directly from the Sudbury ores was that of G. M. Colvocoresses, general manager for the Consolidated Arizona Smelting Co., who owns a patent for manufacture of nickel-copper steel from nickeliferous pyrrhotite. Mr. Colvocoresses proposes to roast the ore in a Wedge or other mechanical furnace to 0.5% sulphur and then either nodulize it and smelt in a blast-furnace, like an ordinary iron ore, with coke and limestone, or smelt directly in an electric furnace. By whichever method the pig is obtained, Mr. Colvocoresses advises refining in an electric furnace. Mr. Stansfield, on the other hand, suggests as a cheaper method, nodulizing the roasted ore, smelting in a blast-furnace, bessemerizing the pig, and removing the last traces of sulphur in an electric furnace.

As the cost of producing the alloy, Mr. Colvocoresses offers the following figures: Mining $2.50, crushing and roasting 50c., sintering and transportation $1. So the roasted and sintered ore would cost $4, or $8 per ton of pig. Coke $2.25, lime 30c., electrodes 60c., electricity $7, labor $3, making a total of $21.15 per ton of pig, and allowing 2008 lb. of pig to the ton of steel, comes to $21.25. To this must be added burnt lime 30c., iron ore 20c., ferro-alloy and manganese 50c., electrodes 68c., electricity $1.15, and labor $3.80, bringing the total cost to $27.88 per ton of refined steel, allowing $2.12 for selling cost. This gives nickel-copper steel at $30 per ton. The weak point in these figures seems to be that two tons of roasted ore should equal a ton of pig. Assuming 40% iron for the ore, which is what is generally allowed, the roasted ore would not be expected to contain more than 45% iron. This, however, would only make a difference of a dollar in the cost on the figures given. The value of the sulphur has not been taken into consideration because the cost of transporting sulphuric acid from Sudbury is prohibitive. In the light of more recent research, however, the possibility of producing elemental sulphur by the Hall or thiogen process should be attractive.

Slush Castings

When a metal or carbon mold is filled with a metal or alloy of low melting-point and the latter, after standing a brief interval, is poured out of the mold again, a shell is left in the mold that takes its form and constitutes a hollow casting possessing a better proportioned wall-thickness than it is possible to get with cores. Such castings usually take the form of more or less artistic articles, such as statuettes for clocks, and lamp bases. The metal is generally zinc, and the metal parts made in this way are known as slush castings. It has been found that the purer the zinc used, the better the castings and the less trouble experienced from cracking. It is common to add a small amount of aluminum to the zinc, as it clears the surface of the metal and makes it run better. About 0.10% or less of aluminum is used, but it is a remarkable fact that, while 2 or 3% of aluminum will cause the zinc to become stiff and slushy, with 5% aluminum the zinc pours well and produces good castings. Since aluminum increases the cost of the zinc, it is generally used as a de-oxidizer for making slush castings, and not for producing an alloy, and the amount added is less than 0.10%. Some manufacturers have found that the addition of not to exceed 0.005% of aluminum increases the fluidity of the zinc and permits slush castings to be made that are free from cold-shuts and cracks. This small amount of aluminum is most conveniently added in the form of a mixing-alloy of zinc and aluminum.—Daily Metal Reporter.

THE equatorial radius of the earth has been computed by the U. S. Coast and Geodetic Survey to be 6,378,283 metres, while the polar radius is 6,356,868 metres. The limit of error falls within 34 metres of the actual length. The flattening at the poles is between 10/2987 and 10/2968 of the radii, with 10/2978 as the most probable value.

Welding Nickel Anodes

In these days of attempts at conservation of every possible waste material, any scheme with this end in view merits attention. It had been the custom to throw away small pieces of nickel anodes from plating-baths, but now the practice of utilizing every pound of nickel anodes for service by welding the scraps together has resulted in saving considerable money at many plating establishments. Until recent years it was usual to sell worn anodes as scrap for want of a thoroughly satisfactory method of utilizing them, and this was a source of considerable loss to the platers, for the junk-value of such material is less than one-half the original cost of the anodes. By welding the scraps together every pound of the costly metal is utilized for plating at a trifling cost for welding. The practice of welding such anodes is as follows: The worn anodes, as they are withdrawn from the tanks, are turned over to some workman who does the welding. A scrap of suitable size and shape is selected as a hanger, and other scraps are tacked to it by welding until the desired size and weight are secured. The tacking consists of melting the scraps, at the point of welding, by the heat of the oxy-acetylene flame, allowing them to fuse into one piece. The tacking of a joint requires but a moment, as the temperature of the oxy-acetylene flame, which is approximately 6300° F., causes the metal to fuse quickly. No flux is used. Where necessary another piece of scrap-nickel is used as a filling-rod. The same flame is also used to remove the brass hooks from the scraps, the solder melting rapidly, leaving the pure anode to be welded.



WELDING SCRAP NICKEL ANODES

Several other methods of utilizing scrap-anodes have been tried in the past, but with uncertain results. The method of fastening them together by means of rivets and similar means are seldom dependable because of uncertain conductivity. It is impracticable for anyone but the manufacturer to re-melt and re-pour anodes, because in so doing the composition is changed. A decided advantage in welding the scraps together is that the original composition is not changed, and the fused joints insure conductivity equal to that of new anodes. Another advantage is the fact that no skill or experience in the art of welding is required to weld scrap-nickel anodes. Any workman of average intelligence can do it without previous knowledge of the process. The welding apparatus required is inexpensive. The illustration shows the welding of scrap anodes by the Prest-O-Lite process of oxy-acetylene welding. Welded anodes are seen in the foreground.

Silver-Coinage Ratio

The United States ratio in dollar coinage is 15.988, which brings the gold coinage value of an ounce of fine silver to $1.2929. Coinage of dollars has been discontinued since 1904. The weight of our subsidiary coinage, that is, half dollars, quarters, and dimes, is about 6.46% less in proportion to the silver dollar. As the fineness of the coins is the same, the seigniorage is correspondingly larger. Most other nations follow the same course. The Latin Union, comprising France, Italy, Switzerland, Belgium, and Greece, and those that have adopted the same system in whole or in part, namely Spain, Rumania, Bulgaria, Servia, Russia, and Finland, have as a unit a silver coin on the basis of 1 to 15½, a ratio equal to a gold-coinage value of $1.3336 per ounce of fine silver. The subsidiary silver of these countries is coined on the still smaller ratio of 1 to 14.38, equal to $1.438 per fine ounce of silver. England's coinage is all on the ratio of 1 to 14.288; that of the German empire on 1 to 13.95. The Scandinavian countries have a monetary union, and their silver coins are minted on a ratio of 1 to 14.78, and Holland's silver coinage is all on a 1 to 15.63 basis. As far as European countries are concerned, it will be seen that the price of the white metal will stand a much higher valuation before coinage would have to be curtailed.

Chrome Brick in Copper Reverberatory Furnace

By FRANCIS R. PAYNE

*Several years ago one of the large Eastern copper refineries decided to utilize basic in place of silicious material in the walls of reverberatory furnaces for the treatment of foul blister copper, as the latter rapidly corroded the silicious linings. It was expected that there would be less slag formation, with a consequent decrease in the cost of treatment and a reduction in the metal losses. Magnesite-brick was first used, but while the corrosive action of the foul material was greatly reduced, and the amount of slag formed was much less, the magnesite proved to be unsatisfactory in parts of the furnace because of its tendency to crack and spall when subjected to alternate heating and cooling. It was decided to substitute chrome-brick in the parts of the furnace that were affected. The results, as far as the reverberatory furnace was concerned, were satisfactory. The corrosion was small and the amount of slag formed was no greater than when using magnesite, and the tendency shown to crack and spall was eliminated. Gradually the use of chrome-brick was extended to furnaces treating blister copper as well as those melting cathodes, and the results were so satisfactory that the silicious roofs were replaced by roofs of chrome-brick except where experience showed a more satisfactory performance on the part of the silica-brick. It was immediately recognized, both for the magnesite and chrome-brick, that the absorption of metal was heavy, but it was felt that the longer life of the furnaces and the decreased cost of slag treatment and metal losses would more than offset the disadvantage.

When repairs had to be made, the resulting 'cobbing' was sent to the blast-furnaces for the recovery of the copper, silver, and gold. It was, of course, realized that chrome was a neutral material and could not be fluxed, but it was thought that, at the blast-furnace temperature, the cobbing would be melted, releasing the absorbed metals and causing the chromium oxide to pass out mixed with the blast-furnace slag. For a time this method appeared to be satisfactory, but as more of the cobbing was made and treated in the blast-furnaces, trouble developed. The capacity of the settlers began to be seriously reduced and slag-losses increased, due to improper settling. It was found that there had formed in the settler, between the matte and the regular slag, a layer of thick mushy slag. This could not be fluxed, could not be tapped out with the matte, and would not of itself overflow through the slag-spout. The only way to remove it without shutting down and digging it out, was to insert a pipe into the layer and, by use of compressed air, cause it to mix and overflow with the regular slag. While this procedure cleaned the settler, it also resulted in metal-losses that could not be tolerated. Samples of this mushy slag showed it to contain as high as 25% chromium oxide, indicating that the cause was in the chrome-cobbing added to the charge. On discontinuing the treatment of the cobbing, the trouble disappeared. The result was to accumulate a considerable stock of chrome-cobbing, and experiments were undertaken to devise a satisfactory process for the removal of the metals so as to leave a residue that could be sent to the dump.

The cobbing was crushed fine, thereby releasing the larger metallic particles, and treated in a reverberatory furnace with roasted pyritic ore and silica. This gave a fairly fluid slag in which the chromium was apparently soluble. A considerable amount of the metal was thus recovered, but the slag was still too rich in copper to throw away, and when sent to the blast-furnaces, induced a return of the former troubles in the settler. Fine crushing and fusion with a low-grade matte was expected to remove the metals and leave a slag sufficiently low in copper to be discarded. The results were unsatisfactory, for although the matte absorbed much of the metal, yet the slag was thick and pasty and contained considerable copper. It was believed that crushing, followed by mechanical concentration, might separate the metal from the brick. Accordingly, the material was crushed and screened to remove the coarse metallics, and was then treated on a Wilfley table. Sizing resulted, but little concentration took place. The entire structure of the brick proved to be saturated with finely divided copper and copper oxide. Flotation was also tried without success, as the concentrate was too rich in chromium and there was too much metal in the residue. The most satisfactory solution yet found for the disposal of this material is to grind it, thereby freeing the larger metallic particles, and utilize the fine material in the manufacture of refractory brick, thus using the cobbing over and over again. Some slagging occurs, of course, and a certain amount of chromium goes to the blast-furnace, where the mushy slag is formed, but in small amounts it is easily taken care of, and eventually the accumulated stock is 'worn out' and sent to the dump.

This experience suggests that chrome-brick is not very desirable for this class of work, and that magnesite should be used if possible. Experiments indicate that the tendency of the magnesite to crack and spall can be overcome by subjecting the brick to pressure before burning, which should also cause less absorption of metal. There is also no difficulty in treating the cobbing in the blast-furnace.

*Abstract: Bull. A. I. M. E.

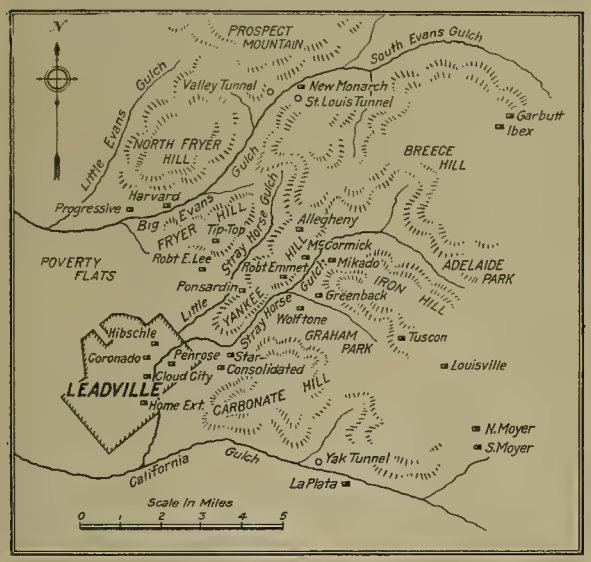
Colorado Metal Production in 1917

The mine output of gold, silver, copper, lead, and zinc in Colorado for 11 months of 1917, and the estimated output for December, according to data compiled by Charles W. Henderson, of the U. S. Geological Survey, amount to about $16,020,000 in gold, 7,327,000 oz. silver, 67,500,000 lb. recoverable lead, 8,700,000 lb. copper, and 114,000,000 lb. recoverable zinc, having a total value of nearly $40,600,000, compared with $19,153,821 in gold, 7,656,544 oz. silver, 70,914,087 lb. lead, 8,624,081 lb. copper, and 134,285,463 lb. zinc, having a total value of $49,200,675 in 1916.

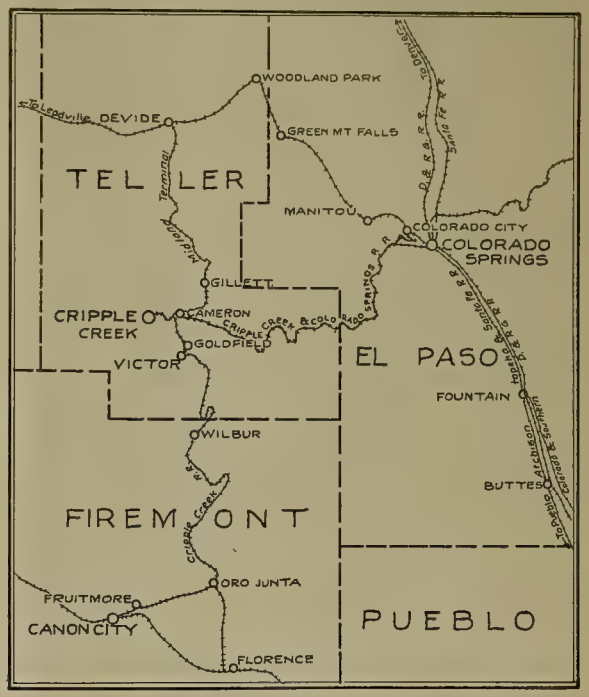
The lead smelters at Globe, Leadville, Pueblo, Durango, and Salida were operated about as in 1916, the ore coming from Arizona, Canada, Colorado, Idaho, South Dakota, and other States, and including a large amount of zinc residues from Kansas and Oklahoma smelters. The flotation plant installed in 1916 at the Durango smelter to remove the zinc from the zinc-lead sulphide ores of the San Juan region continued to be operated during 1917. The copper-matting plants at Ouray and Vulcan were idle. The United States Zinc Co.'s magnetic wet-concentration mill and zinc smelter at Pueblo were actively operated on zinc ores from Colorado and other Western States. The Western Chemical Co.'s acid plant and magnetic-separation wet-concentration mill at Denver and the Empire Zinc Co.'s 200-ton magnetic-separation plant at Canon City were operated steadily, both treating chiefly Leadville lead-zinc sulphide ores. The River Smelting & Refining Co.'s plant at Florence continued to treat zinc-lead-copper sulphide ores from several counties in Colorado, part of the product being forwarded to this company's electrolytic zinc plant at Keokuk, Iowa. The Western zinc-oxide plant at Leadville was operated steadily on zinc-carbonate ores. Copper ore and cyanide precipitates were shipped from Colorado to the smelter at Omaha, Nebraska, and some copper and lead ores were shipped to plants in Utah.

As predicted in the six months' review of operations, the production from Cripple Creek was less than in 1916, but the production during the last six months of 1917 was somewhat larger than during the first six months, and the total production of Cripple Creek for the year was $10,549,000, a decrease of $1,570,000. During the year the Roosevelt adit was continued so as to end at the Portland mine, not at the Golden Cycle-Vindicator mine, as originally intended. A cross-cut was also started toward the Cresson mine. The Portland company abandoned its plan of using the flotation process in its Independence mill and continued to use the cyanide process with considerably increased capacity. The Vindicator company continued its experiments with the flotation process. The Golden Cycle cyanidation mill, at Colorado City, and the Portland cyanidation mill, at Colorado Springs and Victor, were operated steadily. The yield from the small cyanide plants of the Cripple Creek district was not so large as usual and the shipments of smelting ore directly to smelters fell off considerably.

Lake county, chiefly Leadville, but including also the



THE LEADVILLE DISTRICT



CRIPPLE CREEK DISTRICT AND ADJOINING DISTRICTS

Lackawanna Gulch, Sugar Loaf, St. Kevin, and the Wortman lode districts and the Arkansas River dredge district, produced $1,208,000 in gold, 2,240,000 oz. silver, 20,000,000 lb. lead, 2,177,000 lb. copper, and 59,500,000 lb. zinc, having a total value of $10,700,000, against $1,720,440 in gold, 2,931,281 oz. silver, 2,621,675 lb. copper, 21,719,392 lb. lead, and 76,785,567 lb. zinc, having a total value of $16,082,059, in 1916. Shipments of manganese-iron ore, manganese-silver fluxing ore, lead carbonate, and zinc-carbonate ores continued in increasing quantities from the Downtown district, unwatered in 1916. Some zinc-carbonate and zinc-sulphide ores were shipped from the Fryer Hill district, also unwatered in 1916, and considerable iron-sulphide ores were shipped from the unwatered Carbonate Hill district. The output of zinc carbonate from the Leadville district decreased heavily. The output of zinc carbonate was 68,500 tons of 19.6%, as compared with 85,513 tons of 21.52% in 1916. The zinc-sulphide smelting and concentrating ore was 130,000 tons of 21.7%, against 147,295 tons of 20.96% in 1916. The Derry Ranch dredge, below Malta, continued operations during the year.

The San Juan region of Dolores, La Plata, Ouray, San Juan, and San Miguel counties produced $2,588,000 in gold, 2,556,000 oz. silver, 20,824,000 lb. lead, 3,745,000 lb. copper, and 6,700,000 lb. zinc, valued in all at $8,100,000, against $3,041,275 in gold, 2,224,311 oz. silver, 16,345,768 lb. lead, 3,072,199 lb. copper, and 5,364,209 lb. zinc, with a total value of $7,107,294 in 1916. The San Miguel county mills maintained their production of gold, which was about $2,000,000, and increased their production of silver to over 1,000,000 oz., but considerable quantities of the ore treated in these mills came from operations in Ouray county along the strike of the veins. San Juan county produced considerably less gold but made an appreciable increase in the output of silver and a large increase in the output of lead, copper, and zinc. The yield of zinc in Dolores county increased heavily, but the yield of the other metals fell off somewhat. In Ouray county there was naturally a heavy decrease in the output of gold, due to the idleness of the Camp Bird mill, both the mine and mill having been closed-down in August 1916 to await the completion of the low-level adit, which was driven steadily during 1917. This adit is to be 10,700 ft. long and will cut the Camp Bird 450 ft. below the present deepest workings and 800 ft. below workings of the next most important section.

Boulder, Gilpin, and Clear Creek counties produced $808,000 in gold, 956,000 oz. silver, 1,240,000 lb. copper, 6,336,000 lb. lead, and 3,300,000 lb. zinc, as compared with $1,001,489 in gold, 881,518 oz. silver, 1,243,756 lb. copper, 5,681,392 lb. lead, and 2,572,575 lb. zinc in 1916. Boulder county produced $50,000 less gold and 12,000 oz. less silver, also less copper and lead. Clear Creek county increased its output of silver, lead, copper, and zinc, but decreased considerably its output of gold. The production of gold in Gilpin county fell off approximately $100,000, but there was an increase in the output of lead, and for the first time in years there was an output of zinc.

In Chaffee county the output of gold, lead, copper, and zinc fell off, but the output of silver increased. The output of Pitkin county (Aspen) was 649,000 oz. silver and 13,633,000 lb. lead, an increase of 71,000 oz. silver, but a decrease of nearly 4,000,000 lb. lead. The output of zinc from this county, however, increased approximately 300,000 pounds.

The production of Creede (Mineral county) fell off considerably, as did that of Gunnison county. Summit county produced $623,000 in gold, 157,000 oz. silver, 620,000 lb. lead, 30,000 lb. copper, and 19,000,000 lb. zinc, as compared with $673,891 in gold, 120,207 oz. silver, 14,581 lb. copper, 1,688,637 lb. lead, and 13,940,948 lb. zinc in 1916. The four gold dredges at Breckenridge produced about the same output as in 1916, but the output of pocket gold was not equal to that of 1916. During the later part of the year a new dredge was launched in this district. There was very little activity at Montezuma, but several properties continued to work at Kokomo.

Mining was active at Red Cliff, Eagle county, though the yield of zinc was somewhat less than in 1916. Some shipments were made from the Brush Creek district. The output from both lode and placer mines in Park county decreased. The output from the mines of Custer county was the largest for several years, and there was also a considerably increased production from the Kerber Creek district of Saguache county.

THE largest output of ground barytes is made by three Missouri companies. The establishment of a grinding-plant at Cartersville, Georgia, by Thompson-Weinman & Co. will do much toward increasing the production of Georgia and Alabama mines, as it will give a ready outlet for small lots of barytes mined from various deposits. It is reported that a company is contemplating the grinding of barytes at a plant near Los Angeles, California, now used for other purposes. Such a step might be welcomed by the Pacific Coast makers of mixed paints, who now obtain their ground barytes in the East and pay high freight-rates to the coast. White bleached and floated ground barytes is used in ready-mixed paints, in the rubber industry, and in making stiff heavy cardboards and papers. Off-color ground barytes is used in preparing colored mixed paints and in various chemical industries. There is at present a fair demand for domestic barytes. Quotations on prime white or floated material range from $30 to $36 per ton, and for off-color from $22 to $24. The output is increasing, but is retarded by shortage of labor and difficulties of transportation.

TAXING net earnings of mines alone, says Lewis E. Young, fails to reach the non-producing mine which yet may possess some value; also valuation based on net earnings may not take a proportionate share of revenue from mines.

REVIEW OF MINING



MAMMOTH, UTAH

MAY DAY.—TINTIC BONANZA.—TINTIC STANDARD.—EAGLE & BLUE BELL.—TINTIC MILLING.—DRAGON CON.

Owing to the holidays the metal output of the Tintic district was materially reduced during the week ended December 29, being almost 50% below normal. The shipments were as follows: Dragon, 26 cars; Chief Consolidated, 14; Eagle & Blue Bell, 14; Tintic Standard, 10; Centennial Eureka, 9; Iron Blossom, 8; Colorado, 6; Mammoth, 6; Grand Central, 5; Gold Chain, 5; Victoria, 4; Chief Con. manganese lease, 3; Empire mines, 2; Scranton, 2; Minnie Moore, 1; Golden Key, 1; Victor Con. 1; Yankee, 1; making a total of 118 cars.——While the past year has been an uneventful one for the May Day, the work which is now being done on the 700-ft. level to the east of the shaft is promising. Already some small bunches of ore have been found and it is hoped that a continuation of this work will result in the discovery of another orebody.——At a meeting which was held recently at Salt Lake City it was decided to turn over the stock of the Tintic Bonanza Mines Co. in exchange for shares of the Eureka Standard Con. M. Co. on a basis of 100 shares of Eureka Standard for 127 shares of stock in the Tintic Bonanza.——Today the Tintic Standard is one of the biggest mines in the district; there are thousands of tons of ore in sight and the company has a large tract of undeveloped ground, owning one of the largest tracts of mineral land in Tintic. A recent strike has been made a short distance to the north of the new shaft, where a large body of ore averages 70 oz. silver, $5 to $6 in gold, 10 to 12% lead, and from 2 to 3% copper. The main ore-channel has now been opened for 500 or 600 ft.——A report was received from D. E. McPherson, the superintendent of the Deseret Mountain property, that the station on the 300-ft. level of the new shaft had been completed and the work of sinking had been resumed. When the 300-ft. level was reached a cross-cut was run into the vein, which proved to be 30 ft. wide. The vein was 6 ft. wide at the surface. Two drifts have been run north and south on the vein from the cross-cut. The shaft will be sunk to the 500-ft. level as fast as possible.——The Plutus property is being developed at three different points. A drift is being driven from the Victoria shaft into the Plutus ground, another drift is being run from the Chief Consolidated workings, and a force of men is at work in the shaft. The shaft is down 400 ft., where a drift had been started to the south. At the time the Plutus was taken over by the Chief company the stock was selling at 14c., now it is up to 35c.——Eagle & Blue Bell Mining Co. is one of the district's heaviest producers, but has suffered more than any other mine on account of embargoes that smelting companies have placed on ore. The Eagle shipped a total of 625 carloads of ore, and it is estimated by the company's officials that this is not half the amount that the mine is capable of producing. The mine is equipped with gear capable of hoisting 300 tons per day, but at times during the past year it has almost been necessary to suspend operations because the embargo prevented the mine from shipping. ——Iron Blossom Mining Co., controlled by Jesse Knight and associates of Provo, is the third largest producer in this district. During the past year this mine has sent out 1201 carloads of ore, and has paid regular quarterly dividends of 5c. per share. The principal constituent of the ore is copper, although lead, silver, and gold are also present.——Tintic Milling Co. was organized over two years ago, and for several months has been operating a custom-mill at Silver City to treat the low-grade ores that cannot be shipped to the smelters. The plant has proved a successful enterprise, and is treating nearly 300 tons of ore daily. Five cars of precipitate have been shipped to the smelters, and four or five carloads of bullion have been marketed.——The Centennial Eureka Mining Co., known in this district as the Blue Rock, was purchased several years ago by the United States Smelting Co., and since has paid millions of dollars in dividends. For many years it was the heaviest producer in the district.——The Tintic Delaware is a new company organized to develop the Ekker group of 14 claims in the West Tintic mining district. Enough ore to load a couple of cars is already on the dump awaiting shipment, and the management intends to commence shipping shortly.——Mammoth mine is one of the oldest and heaviest producers of the camp. It is owned by Samuel McIntyre of Salt Lake City and during the year has sent out 739 carloads of good-grade ore.——The Dragon Consolidated Mining Co. is another company controlled by Jesse Knight and associates, and is one of the oldest mines in the district, having been a producer for more than 40 years. This year the mine leads the list of shippers, having produced 1774 carloads. An average of 34 carloads per week has been sent out, some of the low-grade ore going to the Tintic milling plant and thousands of tons of iron ore to the different smelting companies of the State for fluxing. The Dragon also is sending out considerable ore of a higher grade, which has enabled it this year to pay dividends for the first time in many years.——The Eureka King Mining Co. is a North Tintic property in the vicinity of the Lehi Tintic. Development work has been pushed during the past few months, and at present consists of a shaft which is down 350 ft. The property is owned by Salt Lake people. George Chiulos is managing the work there.——The Copper Leaf Mining Co. is a new company situated in the extreme eastern end of the district adjoining the Tintic Standard. The shaft is down 400 ft.——The North Beck Mining Co. shaft is nearing the 300-ft. level, and sinking is going along as rapidly as three shifts can handle the work.——The Gemini has shipped 457 carloads of ore during the past eleven months. This mine is controlled by Jackson McCrystal of Salt Lake City. The orebody on the 1600-ft. level is one of the biggest that has been found in this mine.

TONOPAH, NEVADA

TONOPAH MINING.—TONOPAH EXTENSION.—TONOPAH BELMONT.—WEST END CON.—JIM BUTLER.

The Tonopah Mining Co. shipped 25 bars of bullion valued at $46,750. The 50th dividend amounting to 7½c. per share has been declared and is payable January 21. The total dividends to date total $14,275,000. At the Silver Top 35 ft. of development has been done, 17 ft. at the Mizpah, and 44 ft. at the Sandgrass. During the past week 2450 tons of ore was milled, averaging $13 per ton. Last week's production was 1950 tons. ——The Tonopah Extension Mining Co. milled 9219 tons of ore during November, resulting in a net profit of $11,719. At

the No. 2 shaft 133 ft. of development has been done and 170 ft. at the Victor. At the No. 2 on the 850-ft. level stoping continues on a 4-ft. face on the Murray vein. At the 1260-ft. level the Merger vein is being worked on a 4-ft. face and the O. K. vein on a 3-ft. face. East and west drifts from cross-cut 510 on the 1350-ft. level are unchanged. Raise No. 567 shows a 6-ft. face of ore. On the 1540-ft. level of the Victor raise No. 1503 made a connection with the level above. Low-grade ore was exposed by the raise. Work in the 1501 winze has been discontinued, pending the erection of an air-hoist. The face of the winze is still in ore. On the 1680-ft. level 1600 south cross-cut was extended 60 ft. The 1600 west drift advanced 32 ft. on a 7-ft. face of good ore. The face of the west drift is about 270 ft. from the west line, where the Cash Boy Consolidated Mining Co. has worked the vein at approximately the same level. Work in the east drift 1600 has been resumed, and shows a 3-ft. face of ore. The production the past week was 2380 tons.——The Tonopah Belmont Development Co. milled 10,310 tons of ore during November, resulting in a net profit of $66,224. On the 800-ft. level the east drift from the south-east cross-cut No. 8013 shows a 3-ft. face of excellent ore, while the west drift shows 5 ft. of ore on the South vein. Raise No. 18 continues to advance on a 5-ft. face of ore on the South vein. On the 1000-ft. level raise No. 73 made a connection proving a fair body of ore. Last week's production was 2147 tons.——At the Ohio shaft of the West End Consolidated Mining Co. drift No. 535 continues in a full face of fair ore. Drift No. 536 made a connection with drift No. 531, proving an excellent body of ore along the strike of the vein. Winze No. 534 is in good ore. On the 555-ft. level drift No. 1 continues in a full face of ore. Raise No. 814 continues in a silicified zone. The stopes at the West End shaft show higher average grade. The output the past week was 959 tons.—— The MacNamara Mining Co. cut the Ohio vein in a raise from the west cross-cut on the 700-ft. level. The vein is wide and of fair grade where it was cut by the raise. The production the past week was 512 tons.——The Jim Butler Tonopah Mining Co. milled 2916 tons of ore during November, resulting in a net profit of $7143. Work has been suspended in the west cross-cut on the intermediate below the 500-ft. level and a raise started to cut the vein above. Raise No. 653 from the intermediate continues on a 4-ft. face of ore. The production during the past week was 559 tons.——On the 1000-ft. level of the North Star on a 2-ft. face of excellent ore a raise is being put up. An intermediate from the raise No. 1050 is being driven on a 2-ft. stringer of ore. A shipment of 56 tons was made last week.——The Montana produced 77 tons, the Rescue 68 tons, and miscellaneous 7 tons, making the week's production at Tonopah 8715 tons with a gross value of $152,513.

MAYER, ARIZONA

General Development Co.—Arizona Binghampton.—Copper Queen.—Consolidated Arizona.

Announcement has been made by directors of the Jerome Copper Co. that ore has been found in the 930-ft. adit in the South Jerome district which was taken over last summer by the General Development Co. It is considered to be one of the most important strikes of ore made during the past year. The vein is about 30 ft. wide, and is a milling-grade of copper-silver ore. Drifts have been started each way on the vein and cross-cutting is in progress, with ore still in the face. J. G. Flinn, the mine superintendent, states that the mine indications could not be better. This strike is of importance to the district because it is the first property to be taken over in he Jerome-Phoenix mineralized belt by this strong Eastern company, and the success of the first attempt will stimulate the company to further development on other properties in the district. The company owns the Christmas mine, three miles east of Mayer, which was the first one acquired last summer. The Christmas mine is right in line with the Arizona Binghampton and Copper Queen mines on the south extension, with only a few claims between. There are places opened up that will run better than 20% copper. The discovery at the Jerome mine is especially gratifying to E. A. Kastner and Homer King, of Prescott, who were instrumental in interesting the General Development Co. in this district.——The Arizona Binghampton company has begun to sink the 600-ft. shaft to the 1200-ft. level. The new shaft is to be three-compartment and there will be a station cut at the 700 or 800-ft. levels. The sinking of this shaft will be watched with great interest for it will determine what may be expected with depth in the Yavapai schist. The main orebody on the 600-ft. level is 51 ft. wide and it is all a milling-grade of copper ore. This same orebody has come down through the several levels above, getting wider and better in grade with depth.——Over the divide from the A B C mine, the Copper Queen company has discovered new ore in a raise from the bottom of the 300-ft. winze. The ore-shoot has widened to seven feet and runs 5 to 6% copper. The development work is now being confined to the winze level. There are a number of promising outcrops on the surface that have not as yet been prospected.—— While no public announcement has been made by the Consolidated Arizona Co. as to the success of the new work on the 1200-ft. level in the Blue Bell mine, it is commonly reported that some ore has been found in the drift to the north that runs higher in gold and about the same in copper as the big orebodies on the 1000-ft. level. On the 1000-ft. level there are stopes 40 ft. wide of milling and smelting grades, and now on the 1200-ft. level the ore found is proving richer. Recent development at the extreme south end of the Blue Bell mine, about 2000 ft. south of the main shaft, has opened an orebody better than 25 ft. wide at a depth of 75 ft. The company plans to run a drift on the 800-ft. level southward to open the new strike at depth.——The new strike in the Pocahontas mine is continuing to grow better every day. The vein is about 12 ft. wide with portions running into high-grade shipping-ore. Some of the machinery has arrived for the new flotation mill. Another promising strike of silver-lead-gold ore has been made in the Black Diamond mine, near Walker, the control of which is owned by J. Irwin, of Prescott. The ore, which covers the bottom of the shaft, runs from $50 to $80 per ton in gold, silver, lead, and copper.

COBALT, ONTARIO

Silver Production.—Temiskaming.—McKinley-Darragh.

The year just ended has been a profitable one for the mines of Cobalt. Of the $16,000,000 produced during the year approximately $8,600,000 is net profit. Of the latter amount about $5,500,000 has been disbursed in dividends, and the balance employed in new ventures farther north in the endeavor to acquire new mining property. During the year the price of silver has averaged about 81.7c. per ounce, which compares with 65.6c. in 1916 and 49.7c. in 1915. The current year's increase above that of 1915 just about makes the difference between profit and loss.——During last week the Mining Corporation and the Nipissing company shipped bullion valued at approximately $200,000. In addition to sending out large shipments of ore, the Mining Corporation has shipped 4,051,966 oz. during the current year. The output from the Nipissing is second only to that of the Mining Corporation; Kerr Lake ranks next.

The O'Brien mine is maintaining a large silver production, the output for the current year being about 100,000 oz. per month; the Miller Lake O'Brien, at Gowganda, is yielding about 84,000 oz. per month.——At the lower levels of the McKinley-Darragh a large tonnage of low-grade ore is being opened up, and some high-grade is also found. The physical condition of the mine is good.——The Chambers Ferland has

found some patches of high-grade ore just above the contact, and here too, considerable low-grade is being broken. The exploration at depth is now well under way and quite an extensive portion of the property heretofore unexplored is in line for early development.

The oil-flotation plant at the McKinley-Darragh has been closed down for the winter and will be re-opened in the early spring. The plant was only completed during the past few weeks, and was kept in operation just long enough to prove it to be satisfactory. However, the economic treatment of the sand from the bed of Cobalt lake could not be carried on during the cold weather. Underground operations at the McKinley-Darragh are of a favorable nature.

TORONTO, ONTARIO

CANADIAN METAL OUTPUT.—GROCH FLOTATION MACHINE.—McINTYRE.—SCHUMACHER.—CONIAGAS.

The Canadian Department of Mines estimates the value of the total mineral production of Canada during 1917 at approximately $200,000,000, as compared with $177,201,534 in 1916. The output of nickel, lead, zinc, pig-iron, and steel showed a considerable increase, while there was a decline in the production of gold, silver, and copper. The principal metallic items were, gold $17,000,000, silver 23,500,000 oz., copper 113,000,000 lb., nickel 84,800,000 lb., lead 56,700,000 lb., zinc 31,000,000 lb., pig-iron 1,186,000 tons, and steel ingots and direct steel castings, 1,735,000 tons. Coal was produced to the amount of about 14,100,000 tons.——The seriousness of the coal situation, which is causing much hardship and loss at many points in eastern Canada, again is directing attention to the extensive peat deposits that might furnish a source of fuel to take the place of the uncertain supply of imported coal. Attempts have been made from time to time, under Government direction, to produce a peat fuel that could compete successfully with coal, but although a satisfactory fuel was produced the experiments proved commercial failures. Now, however, owing to the scarcity and steadily increasing price of coal, conditions have changed so radically that such a scheme would have far better prospects of success than when formerly attempted. Attention is being drawn to extensive peat bogs a few miles south of Cochrane in northern Ontario as a source of excellent raw material for peat-fuel manufacture. In October last a survey of these deposits was made by A. Anrep, an expert of the Canadian Mines Branch, who is in favor of the project, which is expected before long to take practical shape.

The Groch centrifugal flotation system is coming into favor and is being introduced for the treatment of other metals than silver. It has been for some time in successful operation for gold extraction at the Miller Independence mine, Boston Creek, and the McIntyre of Porcupine is arranging to try a Groch machine for experimental work. The system is stated to be suited also for the treatment of molybdenite, graphite, and the recovery of copper from sulphide. A contract has been let for the installation of a flotation plant on a molybdenite property near Amos, on the Transcontinental Railway. The Groch machine is a Canadian invention.

The McIntyre, which recently declared a 5% dividend, is at present the only dividend-paying mine in Porcupine. It is understood that current earnings are considerably in excess of the dividend requirements of 20% per annum. The ore-reserve has been increased considerably by underground operations. A new hoist has been erected with a capacity for operating to a depth of 2000 ft. Some delay was occasioned by water in sinking the shaft on the Jupiter property, but new pumping equipment has overcome the difficulty and the shaft has now nearly reached the 1000-ft. level.——The Schumacher has improved its position lately. Its main workings have been carried to the 600-ft. level and, despite labor shortage, the mill has been kept operating to capacity. Following the example of other successful mines, deep mining will be undertaken and the shaft put down to the 1000-ft. level.——The Davidson has received all of its mill machinery and it is expected that the mill will be ready for operation in about a month. There is $80,000 worth of ore on the dump and enough blocked out underground to keep the mill in operation for two years. The West Dome Consolidated has made arrangements to have its ore treated at the Dome Lake mill. It has 900 tons of $17 ore broken and ready to be hoisted and 6000 tons of ore, running $9 per ton, on the dump. The continuation of the main ore-body of the Porcupine Crown has been cut on the 1000-ft. level, where the ore compares favorably with that of the upper levels.

The Coniagas, of Cobalt, is sinking a 3-compartment shaft on the Ankerite gold property which it acquired recently. Progress is being made at the rate of seven feet per day, which, it is claimed, establishes a new record for quick sinking in northern Ontario. At the annual meeting of the Coniagas Mines on December 31, it was announced that $500,000 had been paid in dividends during the year, bringing the total distribution to shareholders up to $8,740,000. The output of silver was 1,344,267 oz. as compared with about 1,750,000 the previous year. The directors of the Peterson Lake have decided to proceed as soon as possible with the erection of a mill for the treatment of slime on the Seneca Superior dump. An offer, made by the Beaver Consolidated to the Temiskaming of the right to purchase over 870,000 shares of the Kirkland Lake at 40c. per share, giving them an equal interest, was submitted to, and rejected by, the Temiskaming shareholders December 28.

LEADVILLE, COLORADO

METAL PRODUCTION.—MANGANESE AND MOLYBDENUM ORES.

METAL PRODUCTION FROM LEADVILLE MINES FOR 1917

Product	Quantity	Market value	Total value
Gold	60,540 oz.	$20.67	$1,251,528
Silver	2,488,238 oz.	0.8139	2,025,177
Lead	24,952,777 lb.	0.0871	2,169,032
Copper	2,593,943 lb.	0.2726	707,109
Spelter	85,389,235 lb.	0.0873	7,454,481
Manganese	36,272 tons	120.00	4,352,640
Total			$17,959,967
Total for 1916			16,169,557
Increase in 1917			$1,790,410
Grand total value of Leadville output to date			465,563,433

ORE TONNAGE FROM LEADVILLE MINES IN 1917

Carbonate	8,734
Iron (oxidized)	32,073
Manganese	185,391
Zinc (all classes)	214,676
Sulphide (other than zinc)	143,701
Silicious	10,152
Total	594,727
Total tonnage for 1916	455,729
Increase in 1917	138,998
Average value per ton of ore produced in 1917	$30.20
Average value per ton of ore produced in 1916	35.45

Last year the mines of the Leadville district reached their maximum output and set up a new record for gross value of production. The one dominant factor that made possible this remarkable success was manganese. With the exception of lead, all other metals registered a loss as compared with the totals of 1916. Lead showed a gain of 2,200,000 lb. in output

and an increase of over $250,000 in value. Gold fell off 20,500 oz. with a loss of $500,000 in value. Silver, in spite of an increase in value over 1916 of 16c. per ounce, registered a loss in production of over 600,000 oz.; copper dropped over $87,000; and spelter nearly $2,000,000. To make up this total loss of nearly $3,000,000 and still show a gain of $1,750,000 over 1916, manganese closed the year with an increase in tonnage of 103,023 tons. In arriving at the gross value of the manganese output it was necessary to estimate as closely as possible the metal content of the ore and rate it at the highest market quotation. The total production of 185,391 tons of ore represents the wet product as extracted from the mines. Moisture was figured at 15% and reduced from the total, leaving 157,483 dry tons. The average manganese content of this ore, conservatively estimated, was 23%, giving 36,272 tons of metallic manganese. Eastern markets quote manganese at $1.20 per unit on a basis of 48%; and so $120 per ton was used in computing the gross value of the Leadville product. There is a great difference, however, in the price paid to the ore producers that offered the metal in Eastern markets. The highest contract now known to govern shipments from the Leadville mines calls for a price of $10.50 per ton for 30% ore f.o.b. Leadville. This particular ore is shipped to Pennsylvania and is subjected to a freight charge of $14 per ton, making the total cost to the buyer $24.50. From $10.50, the price at the mine runs as low as $4.50, according to the grade of ore. Beginning as early as November of 1916, there was a marked increase in the development of manganese ores. The War brought a steadily growing demand for the metal; and, particularly after the bottoms used in the manganese trade with Spain and South America were being taken up by the Government for other service, the demand rapidly became acute. The market for the ore grew stronger, and with the increased price made a profitable outlet for low-grade material. In 1916 practically all of the Leadville manganese output, amounting to 80,000 tons per year, was shipped to the Colorado Fuel & Iron Works at Pueblo. The bulk of this tonnage was produced by the Star Consolidated Mining Co., which extracts an ore averaging 20% manganese. Some better-grade material was mined in the properties on Poverty Flats but the tonnage was small.——Early in 1917, Eastern ore-buyers made their appearance in the Leadville district and awakened a new interest in manganese. Several large deposits of ore that would average 30% were soon uncovered, the most important discoveries being at the Nisi Prius in Iowa gulch; Bohen, Grey Eagle, Penrose, and Northern in the Down Town section; Fairview on Poverty Flats; Lime and Bulls-eye on Iron hill; and Carbonate on Carbonate hill. These properties all became active producers in 1917 and shipped a heavy tonnage, much of the ore being sent to Eastern buyers, where better prices are secured than are offered at Pueblo. The future of manganese is regarded as bright so far as Leadville is concerned. The output for 1918 is expected to double that of last year and higher prices are looked for coupled with a demand for a still lower-grade product. A number of new enterprises are now being started with the purpose of opening new manganese orebodies.

Aside from the manganese properties, seven big companies stood out last year as the real backbone of the district. The Yak Mining, Milling & Tunnel Co., half of which was sold recently to the American Smelting & Refining Co., was the heaviest producer with a total of over 70,000 tons. The Wolftone shaft of the Western Mining Co., followed with approximately 66,000 tons. The Ibex Mining Co. showed a total output of 50,000 tons; the Star Consolidated Mining Co., 60,000 tons; the Down Town Mines Co., 40,000; the Leadville Unit, 40,000; and the Iron Silver Mining Co., 40,000. Numerous smaller properties combined to make up the remainder of the total output.——The work accomplished by Warren F. Page, manager for the Luema Mining Co., was the most important development undertaken in new territory during the year. A crosscut from the 300-ft. level of the Valley shaft was carried 900 ft. north under Prospect mountain and an immense deposit of low-grade sulphide ore was found in the white lime. A former adit driven from surface near the Valley shaft reached upper-contact ore 1700 ft. from the portal. The presence of the two main Leadville ore-zones under Prospect mountain is now determined. Another big adit to be driven from the Arkansas valley, east under the mountain, is planned for the coming spring.——The re-opening of the old Mikado shaft on Iron hill by the Iron Silver Mining Co., and the discovery last year of immense bodies of rich lead-zinc-silver sulphide ores in the lower reaches of the property was an important event that promises to result in making this mine the biggest producer in the district. The sinking of the Mikado shaft from its present depth of 1135 ft. to 1500 ft. is to be undertaken at some future date to fully develop the ore deposits now uncovered.——At the Wolftone shaft of the Western Mining Co., draining to the bottom level, 1250 ft., has resulted in the discovery of three huge bodies of sulphide ore. These have been found in the Wolftone, Mahala, and Maid of Erin claims, and rank with the biggest ore-shoots now open in the district. The sinking of the Wolftone shaft to greater depth is also to be undertaken.

The Down Town Mines Co., operating through the Penrose shaft, has made a number of important discoveries. Large orebodies have been found on five levels ranging from 300 to 900 ft. in depth. Iron, silver, manganese, lead, copper, and zinc are being produced. The company plans to re-open the old Coronado shaft for hoisting, as much of the ore now blocked out is in this property.——The sale of one-half interest in the Yak to the A. S. & R. Co., and the transfer of the management to the latter corporation is the biggest transaction of the past year. The price paid is stated to have been $500,000. Under the new control, vigorous and extensive development throughout the property is to be undertaken; and it is believed by some authorities that the old objective of the big bore, the piercing of Mosquito range and reaching of the rich gold veins of Park county, will be included in the campaign.

Although not in the Leadville district proper, the recent discoveries of molybdenum at Climax, just over the line in Summit county, are of the greatest importance. During the past year three strong corporations, the American Metal Co., Molybdenum Products Co., and Pingrey Mines Co., entered the field, and the two first mentioned are now erecting milling plants and carrying on development in their holdings. The Pingrey company plans to begin work this spring. A satisfactory process of treatment has been perfected by each of these concerns, and it is believed that a large tonnage of ore will be concentrated during the present year.——The molybdenum deposit on Bartlett mountain near Climax was first discovered several years ago by Charles J. Senter, pioneer prospector of the Ten Mile, or Robinson, mining district, who has made repeated efforts to attract the interest of both American and foreign steel manufacturers to this remarkable deposit. These efforts failed to bear any fruit until 1915, after the War broke out. Then the value of molybdenum was demonstrated fully. England soon perfected a process for using molybdenum in steel and sought a supply of the metal. America was then aroused to the importance of uncovering large deposits of molybdenum, and a market for the metal was established. O. A. King, manager for the Pingrey Mines Co., was first to see the great possibilities of the Bartlett mountain deposits. In 1915 he had a trial lot of 1000 tons of the ore extracted from his property at Climax and treated by flotation at the Leadville district mill. ——The results of this experiment were satisfactory, the finished product being sold for $35 per unit. At that time, however, there was no assurance for a continued market for the metal, but now it is possible to make long-term contracts for the product.



ALASKA

(Special Correspondence.)—Contradictory to a previous report, it is learned on authority that the Willow Creek Mining Co. has not surrendered its lease on the Gold Bullion. It now has a force of men freighting supplies and it plans to drive two headings in the mine during the winter with a view to developing ore.——Herschel Parker of New York reported finding platinum generally distributed in the gravels of streams heading in the Mt. McKinley region. It is not known if in commercial quantity, but the hope is entertained that the combined gold and platinum will make possible the successful exploitation of large areas of dredging ground.——From near Seldovia, on Kenai peninsula, chromite ore carrying 50% chromic oxide was mined and shipped; deposits of chromite and magnetite were reported from near Snug Harbor.

Anchorage, December 20.

ARIZONA

MARICOPA COUNTY

(Special Correspondence.)—Messrs. Warnock and Holmes have taken a bond and lease on the Copper Belt property in the Harqua Hala mountains, 20 miles from Aguila. A road is being built to connect with the road now used for hauling manganese ore to Aguila when complete shipping will commence. The ore is said to run 20% copper and $12 gold.

Phoenix, December 28.

MOHAVE COUNTY

(Special Correspondence.)—A low-level adit has been commenced by the Arizona Butte Mines Co., to cross-cut and develop the many veins which are known to exist in Stockton hill; it will be driven on the Prince George vein.——Considerable progress is being made in the mines of the Union Pass district.——A two-stamp mill is being built at the Arabian property.——A cross-cut on the 400-ft. level to cut the Sheeptail vein is being driven at the Banner.——The shaft on the Lucky Prince is nearing 200 ft. in depth.——It is expected that diamond-drilling will commence within a few days at the Grand Island property. Two 1000-ft. holes are planned.

Kingman, December 28.

YAVAPAI COUNTY

(Special Correspondence.)—It is reported that a 6-ft. vein carrying lead, copper, and silver to the value of $100 per ton has been cut in the 200-ft. level of the Black Diamond.——The shaft of the Arizona Venture has reached a depth of 570 ft. At the 600-ft. level a station will be cut and the orebody will be developed.——The financing of the Copper Valley Mining Co. has been arranged. Work will commence immediately on the road from the mine to Skull Valley station and the shaft on the Snow Drift claim will be sunk on the 500-ft. level.——The south cross-cut on the 700-ft. level of the Verde Combination is 10 ft. in the body of quartz carrying iron pyrite and a little chalcopyrite. It is estimated that the contact is about 15 ft. ahead of the present face.——The Arizona Power Co. has finished the new electric-power line into the Bradshaw mountains. The line is to be extended south into Tiger camp.——The management of the Arizona Binghampton has decided to continue sinking the main shaft from the 600-ft. level to the 1200-ft. level. The present output is 175 tons per day; it runs 3½% copper.——Funds have been raised to continue development at the Montezuma mine at Crown King.——The Palo Verde copper mine in the Black Canyon district is now being worked. Ten tons of ore per day from the old dumps is being shipped by motor-truck to Glendale.——Four feet of fair ore has been struck in the cross-cut which the Jerome Copper Co. is driving to cut the main orebody at the contact.——A new compressor and hoisting engine has been purchased by the Jerome Superior.

Prescott, December 29.

YUMA COUNTY

(Special Correspondence.)—The new 300-ton mill at the Red Cloud Consolidated Mines Co., is in operation. It is estimated that there is sufficient ore developed on the Red Cloud orebody to run the mill for five years. Another orebody to the south has two years' supply of ore developed. The ore is silver-lead but carries some gold and molybdenum.——The Cobrita Copper Co. is sinking a shaft on the 200-ft. level to open up a shoot of high-grade ore that was cut under the old management. The ore-shoot in the drift shows a width of two feet and runs 17% copper and $15 in gold.——T. J. Rogers has interested Prescott people in financing his Emery group of claims in the Buckskin mountains. In the past eight months six carloads of copper-gold ore has been shipped from the property. The present backers have agreed to install a compressor and other machinery, and drive the adit 400 feet.

Bouse, December 31.

CALIFORNIA

ELDORADO COUNTY

(Special Correspondence.)—A vein of an average width of 15 in. assaying $21.12 gold and 7.02% copper has been opened on the Sporting-Boy lode claim, according to Frank C. Fox, the manager. The vein extends 1400 ft. on the claim, and pans free gold for its entire length. The property is being systematically developed by a double-compartment shaft, for preliminary work, three stamp-mills will be erected with which to make mill-tests of the ore as the development of the vein progresses. The property is situated about five miles west of Placerville, on the lower road to Coloma, in the Cold Springs district.

Placerville, January 2.

KERN COUNTY

(Special Correspondence.)—John W. Kelly has discovered platinum in a placer mine at the head of Cuyama valley. The material was identified as platinum in the Kern county assay office.

Bakersfield, January 3.

PLACER COUNTY

(Special Correspondence.)—After being idle for 33 years the Rising Sun quartz-gold mine, one mile west of Colfax, is active. The property was lately taken under lease by D. A. Russell and Lee Gray of Colfax, and is being operated on a royalty basis by Martin & Hathaway of Nevada City. A 10-stamp sampling-mill and cyanide unit have been installed and good ore is being developed. Particular attention for the present

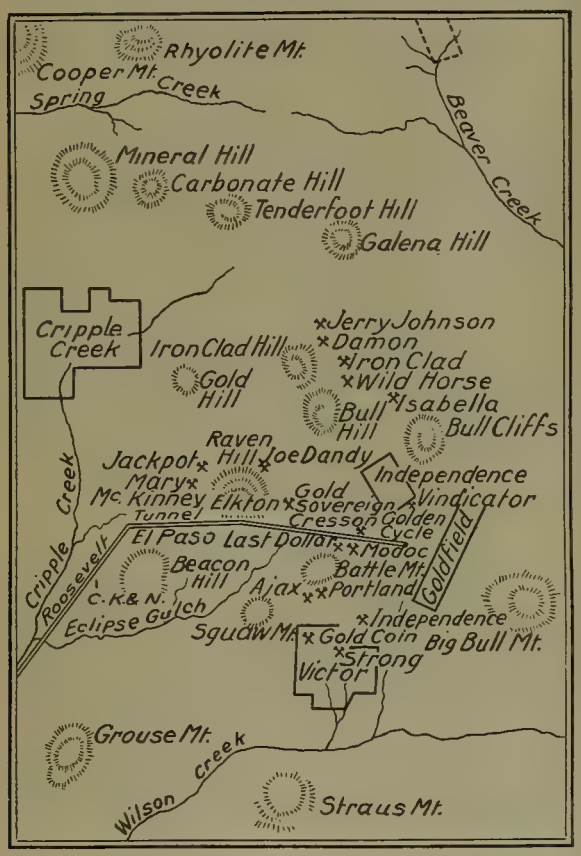
will be devoted to milling of ore from the old dumps and retreatment of large quantities of old tailing. The Rising Sun is 725 ft. deep, and the mine is said to have produced $1,500,000. ——Several properties in the Last Chance district are active, including the Home Ticket, Pacific, and other good producers. Large quantities of supplies have been stored for the winter season; the unusually favorable weather of the past few weeks has facilitated operations.

Colfax, January 7.

COLORADO

TELLER COUNTY

(Special Correspondence.)—Including the December output of 95,750 tons of ore, averaging $12.45 per ton, and having a gross bullion value of $1,073,500, the output of the district for 1917 has totaled 1,006,072 tons, having a gross bullion value of $12,533,177. For the first time in the life of the gold camp the output has exceeded 1,000,000 tons; the average value was



PART OF COLORADO

$12.45 per ton. This heavy tonnage was made possible by the treatment of low-grade dump and ore rejected by the mills of the Cripple Creek district. The two mills of the Portland Gold Mining Co. alone treated 476,050 tons and recovered $899,255. The Victor mill, on Battle mountain, treated 224,195 tons averaging $2.18 per ton, and the Independence mill, originally built by the British Corporation Stratton's Independence, Ltd., but re-modeled by the Portland company, commencing in May, treated 251,855 tons averaging $2.08 per ton. Other local milling plants brought the total tonnage of low-grade ores treated to 494,500, with an average value of $2.11 per ton, and a total bullion value of $1,045,294.

Eight mining companies of the Cripple Creek district paid dividends amounting to $2,674,441 during the year. The companies and the respective rates and amounts follow: Cresson Consolidated twelve dividends of 10c. per share, $1,464,000; Golden Cycle twelve dividends of 3c. per share, $540,000; Portland Gold Mining Co. four dividends of 3c. per share, $380,000; Vindicator Consolidated four dividens of 3c. per share, $180,000; Granite Gold Mining Co. three dividends at 2c. per share, $49,500; United Gold Mines Co. one 1c. dividend, $40,000; Doctor-Jack Pot Mining Co. one 1c. dividend, $28,441.42; Jack Pot Mining Co. one dividend, $12,500. The last named company owns 1,000,000 shares of Doctor-Jack Pot Mining Co. stock and the dividend was paid from this company's dividend.

At the Vindicator Gold mine the Golden Cycle and Vindicator No. 1 shafts continue to produce ore at the bottom levels, 1950 ft. in the Vindicator and 2100 ft. in the Golden Cycle. These deep discoveries have led to deeper development on other properties. The shaft at the Rose Nicol on Battle mountain has been sunk to 1000 ft. by the Camp Bird company. The Modoc Consolidated Co. has its new vertical Frankenberg shaft completed and timbered to a depth of 1100 ft. The Millasier Mining Co. has sunk the Clyde shaft on Battle mountain to a depth of 1500 ft., and the Cresson Consolidated has sunk the main shaft to 1750 ft. and has added an ore-reserve estimated at $1,000,000.——The Roosevelt tunnel of the Cripple Creek Deep Drainage & Tunnel Co. has been advanced 1800 ft. The heading is now in Rose Nicol territory, on the northwestern slope of Battle mountain, a total distance of 23,715 ft. from the portal. The work was started in July 1907. The flow from the tunnel has dropped to 4000 gal. per minute and the district has been effectively drained to a depth of 2000 ft. ——Mining operations during the past year have been handicapped by labor shortage, many miners having left for silver, copper, and zinc camps, where a higher scale of wages obtains, although the scale was raised in the gold camp to a minimum of $3.50 per day. Operating expenses were further increased by the high cost of explosives and mining supplies. New work, however, has been undertaken, in several sections of the district, and the prospects for 1918 are for normal conditions and production.

Cripple Creek, January 5.

In the Cripple Creek district Carl Evans, superintendent for the United Gold Mines Co., has opened a new body of milling-grade ore at the 500-ft. level of the Wild Horse mine near Midway, on Bull hill, and has commenced hoisting. A shipment of the ore will be loaded out shortly, and with the shoot holding up as expected, production will be steady. The development work at the 1250-ft., or bottom, level continues to be satisfactory.

KANSAS

CHEROKEE COUNTY

Some rich blende assaying 64% zinc has been taken from the Merrill mine south-west of Baxter Springs. The ore that assayed so rich was in the form of crystals and was almost prismatic. The average assay record of the ore in this mine is higher than many others which are considered good producers. The Merrill Mining Co. is capitalized at $750,000 and was the first mining concern in this field to put up a lodge for the members of the firm, and another for the workmen and mine operators. The orebodies were discovered in the drill-holes at the 160-ft. level. In one hole the drill-cuttings indicated a 41-ft. face of lead and underneath a 23-ft. face of jack. The members of the company are W. E. Merrill, president; G. Huttig, secretary and treasurer; A. C. Wallace, vice-president.

The Dick Turpin concentrating plant, situated on a lease of the Riseling land, south-west of Joplin, has been purchased by the American Metal Co. and will be moved in the near future to the company's recently acquired leases west of Baxter Springs. The Dick Turpin mill was built by D. W. Sparks and

associates about two years ago and is one of the good mills of the district. It will be moved to a tract of the R. F. Hartley land, where a mill-site has been graded.

Final details in the sale of the Miami Zinc Syndicate's tract west of Baxter to the American Metal Co. have been closed. The purchase price has not been made public.

MISSOURI

JASPER COUNTY

The Butte-Kansas mining plant at Waco was destroyed by fire on Christmas morning, with a loss estimated at $75,000. There was $50,000 insurance. The origin of the fire is unknown. The mill was completed only a week ago and had just started making concentrate. It was a 400-ton plant, being one of the good ones of the field, and was built on the Coyne lease of Hurlbut land, just north of the Liberal mine and south of the Waco Mining Co. property. A portion of the equipment was obtained from the Meadville Mining Co. property, at Carterville, but much new machinery had been added and the plant was thoroughly modern throughout. E. A. Wiltsee was manager of the property, which is owned by Eastern capitalists. As the ground is exceedingly rich it is expected that the mill will be re-built at an early date.

An official statement from the management of the Unity and Concord Mining companies of Webb City as to the production of the two properties during the twelve months closing December 31, shows that the year has been a good one. There has been a total tonnage of concentrate produced amounting to 5559 tons, or more than 11,000,000 lb. The two mines are owned by virtually the same people, including Phil Gray and associates of Webb City. The Concord mill is of 300 tons capacity and is situated in the south part of Carterville. It was completed last spring and was placed in operation in April. The production since that time has amounted to 3,294,880 lb. of zinc-blende and 782,000 lb. of lead. The Unity mine is situated in the Oronogo bottoms, north of Webb City, just north of the D., C. & E. property, and has been going steadily for the past year, the mill having been built in 1916. In size it is approximately the same as the Concord, but the production, due to the more extended operation, has amounted to 5,474,750 lb. of zinc concentrate and 1,649,430 lb. of lead. Both mines are sheet-ground properties, producing a high-grade concentrate and with ore that has been giving a good recovery for sheet-ground properties.

MONTANA

LEWIS AND CLARK COUNTY

(Special Correspondence.)—Severe cold has given place to warmer weather and the result is that more ore is moving from the various mines. The Helena mine in Grass Valley is sending out two carloads of silver-lead ore per week and there is a large tonnage in sight. A new skip with a capacity of two tons is being used. W. F. Word is general manager and consulting engineer. The shaft is to be deepened to 400 ft. before spring. The Cruse Consolidated and Rock Rose, adjoining claims, are sending ore to the smelter. In the Scratch Gravel hills four mines are shipping. The principal mines are the Thomas Cruse Developing Co. property and the Scratch Gravel Gold. The former is mining ore on the 600-ft. level and the latter is taking ore from the 300-ft. stopes. In Marysville camp the Barnes-King is working the Shannon and the Piegan-Gloster. The product is milled at Gloster. The returns from all of the mines worked by the Barnes-King are upward of $100,000 per month. The Mt. Washington mine at Wickes is sending out two carloads of silver-lead ore to the smelter daily from the 800-ft. level.——A rich strike of silver ore has been made in the old camp of Elkhorn.——A discovery has been made recently in the Gould placers above Rimini. The vein was discovered by accident in excavating for a reservoir. The shaft is down 60 ft.; the ore assays 500 oz. in silver and $100 in gold.

Helena, January 1.

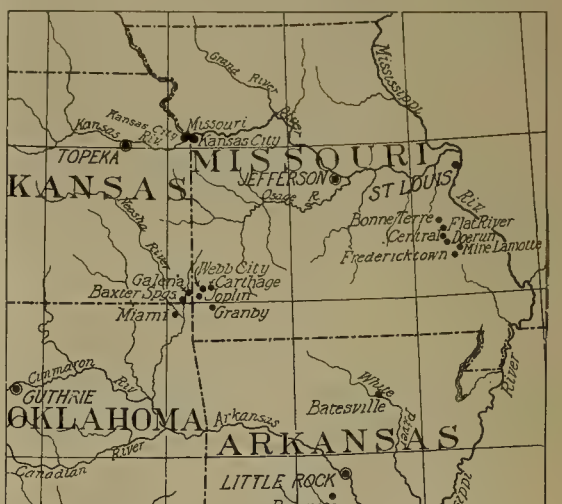
OKLAHOMA

OTTAWA COUNTY

(Special by Telegram.)—The Miami district produced 155,084 tons of blende, valued at $11,884,855, and 26,782 tons of lead ore, valued at $2,960,000, in 1917.

Miami, January 5.

An excellent ore-cave has been discovered in sinking a shaft on the Blackhawk Lead & Zinc Mining Co. lease on the Walker land, south-east of Picher. The cave was struck at 228 ft. It is 10 ft. from the floor to the roof and the sides, roof, and



THE KOMSPELTER REGION

bottom all are lined with crystallized lead and zinc ore. According to drill-holes put down on the lease a 30-ft. deposit of ore is apparent. The cuttings were said to assay around 18%. The orebody was found at 218 ft. and went down to 248 ft. J. Younts of Sikeston, Missouri, is president and Jack Williams of Miami, secretary and treasurer. R. C. Ulmer is the superintendent. The shaft already down will be used as a mill-shaft. A field shaft will be started at once on a nearby portion of the lease.

The Greening Mining & Smelting Co. is constructing a concentrator one mile south-east of Century. The Greening company is a subsidiary of the Hare Mining & Milling Co., which recently completed a big mill on a 20-acre lease near Picher. The officers of the two companies are: Alfred Hare, president and general manager; J. D. Carruthers, vice-president; W. F. Hearne, secretary; A. E. Fritsche, treasurer. W. M. Briten has charge of the construction of the new mill.

NEVADA

ESMERALDA COUNTY

(Special Correspondence.)—The underground force at the Red Hill Florence has been increased and preparations begun for vigorous developments on the 700-ft. level. Stations will be cut on the 600 and 700-ft. levels and drifts started from both points to seek the Florence vein. Several drifts and raises are advancing from the 500-ft. level to explore promising ground and to thoroughly develop the rich shoots lately opened by lessees.——An 18-in. vein of sulphide ore has been opened

on the 700-ft. level of the Silver Pick, and appears to be the same vein that has been developed on the 250-ft. level. At this point ore assaying $6 to $16 per ton in gold is exposed. The drift is advancing to seek the junction of two veins on the 250-ft. level. A drift and raise are being driven from the 500-ft. level, the raise intended to connect with the 250-ft. workings.——Splendid ore continues to develop in the Tonopah Divide mine in the Gold Mountain district, 38 miles south of Goldfield. At a depth of 450 ft. the vein is said to be 20 to 25 ft. wide, averaging $15 to $25 per ton in gold and silver.—— On the 125-ft. level of the Butte Goldfield the vein has widened to two feet, assaying $14 to $16 per ton in gold. An accompanying 6-in. vein assays $64 per ton. A station will be established at the 150-ft. point and drifts thrown out to develop the orebody. L. L. Patrick, of Goldfield, is president.——The Silvermines Corporation, operating at Hornsilver, is sending 150 tons of ore daily through the mill and reports an excellent extraction. The hoist will be replaced shortly by a hoist driven by a high-powered engine operated by compressed air. The company is preparing to use a 150-ft. cross-cut for storage of compressed air, sealing the cut with a concrete bulkhead. By this arrangement a single pipe will be used for charging the cross-cut and delivery of the compressed air to the equipment. As soon as the shaft attains a depth of 700 ft. a station will be cut and sinking continued to the water-level. S. E. Brady is manager.

Goldfield, January 6.

UTAH

UINTA COUNTY

The Crane Shale Oil Co. of Reno has purchased 200 acres of oil-shale deposits at Watson from New York and Salt Lake City owners for $100,000. The deposit is said to have a depth of 80 ft. The shale will be treated by the new Crane process.

WASHINGTON

FERRY COUNTY

While engaged in the development of its property, the Virginia Mining Co., operating near Danville, has received $27,000 net for ore shipped to smelters this year. The total output is 2000 tons. The ore of shipping grade is in a body 4 to 8 ft. wide on the foot-wall and 4 to 14 ft. wide on the hanging wall. One of these bodies is 150 ft. long. This is at a depth of 225 ft. Another level is expected to enter these orebodies at a depth of 500 ft. It will probably reach the objective within 60 days. The ore at 225 ft. contains 2½ to 3% copper and $18 to $22 in gold per ton. Shipments have been proceeding at the rate of two carloads per week. The last two cars, composed of 44 to 50 tons, brought more than $2000 after the deduction of freight and treatment charges. The property was acquired on a bond and lease for $50,000, expiring in June 1920. The company has paid a royalty of $2700, which is at the rate of 10%, and met the bond payment recently. It acquired an adjoining property for $6000 this fall. Twelve men are employed. The number will be increased when the ground is opened on a broader scale. Buildings, ore-bins, and a compressor were erected this year. About 800 ft. of work has been performed in the lower adit.

CANADA

BRITISH COLUMBIA

The Granby Consolidated Mining, Smelting & Power Co. produced 2,886,489 lb. of copper in November. The Anyox plant produced 2,458,841 lb., and the Grand Forks plant 427,648 lb. of this quantity.

The production for November is about 75,000 lb. less than that for October and about 320,000 lb. less than November 1916. The reduction results from a lessened output from the Grand Forks plant, the output of Anyox in November having been greater than in October. This is accepted as an indication that some of the changes at Anyox have been completed. Granby has adhered to its dividend rate of $10 per annum; it has but 150,000 shares of issued capital and $2,514,400 bonds due in 1928. Its quick assets on June 30 were $5,219,000. At $66 per share and par for the bonds, less the above quick assets, the whole Granby mine, smelter, converting, and powerplants are given a valuation of but $7,500,000, or less by $1,500,000 than the combined profits of the fiscal years of 1916 and 1917. At the annual meeting of Granby stockholders last October, it was stated that the operation of the contemplated coal and coke company was expected to effect a saving of possibly 50% in the cost of coke for the company's own requirements. The production of coal will probably exceed the quantity consumed by the company in its metal operations. The Grand Forks property has become less important as an operating factor for the Granby, as revealed in the constantly declining copper output from month to month. Last month's yield of less than 500,000 lb. was the smallest production recorded for over a year, barring the July total of 280,000 lb. At that time the property was in process of resumption after a two months' idleness caused by a strike.

The following amounts have been disbursed in dividends by some of the principal mines during 1917:

Con. M. & S.	$ 996,503
Granby	1,499,848
Hedley	240,000
Le Roi No. 2	29,199
Rambler-Cariboo	35,000
Standard	300,000
Utica	64,000
Total	$3,164,550

Increase of the capitalization of the Lucky Jim zinc mines to 6,000,000 shares from 2,500,000, par value $1 each, is proposed in a special resolution to be presented to the stockholders at a general meeting to be held at Victoria, January 12. The increase will enable the company to absorb $125,000 in bonds, discharge other obligations, and provide a surplus of treasury stock for the improvement of the property, it is stated in a circular issued by Walter J. Nicholls, secretary.

One of the best strikes of recent years in the Slocan district has been made on the Hidden Treasure claim of the Noonday Mines Co., according to a report from Kaslo. More than seven feet of ore has been exposed at a depth of 400 ft. A foot of the body has an average content of $7000 to $8000 net to the carload of 30 tons with silver at 86c. Ore from the same vein, lost 15 years ago, yielded $5000 net to the carload when the price of silver was in the neighborhood of 55c. The Hidden Treasure adjoins the Richmond-Eureka of the Consolidated Mining & Smelting Co. which is credited with a yield of $1,500,000 in ore taken from a shoot of this kind. Search for ore in the Hidden Treasure began many years ago, and when found it disappeared after producing about $40,000 worth of ore. The search was renewed by the Noonday company two years ago. Working on another theory Bruce White, manager, sought the body in a different section than that explored by the pioneers. He operated steadily, although with a struggle at times, removed $16,000 in the course of the investigation, and had no indebtedness when the ore was struck several weeks ago. The shoot has been followed 30 ft. The milling ore is of a superior quality; it contains lead and silver and little zinc. This ore will be concentrated in the mill of the Slocan Star if arrangements can be made with that corporation. The properties are on the opposite sides of the same hill, and their workings are so situated that the removal of Noonday ore can be done with economy through the Slocan Star mine. The course and situation of the body suggests that it may be found in the Slocan Star.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

DONALD F. IRVIN is at Antofagasta, Chile.

JOSEPH IRVING is at Hurley, New Mexico.

W. G. SWART, of Duluth, is at New York.

D'ARCY WEATHERBE writes from Shanghai.

VICTOR RAKOWSKY, of Joplin, is at Washington.

H. R. BANKS is Lieutenant in the Canadian Engineers.

E. D. MCDERMOTT has returned to London from Siberia.

RENSSELAER H. TOLL has returned to Berkeley from Arizona.

R. A. VARDEN has returned to England from Western Australia.

H. H. NICHOLSON is in the Saline Lake district of north-west Nebraska.

M. E. MACDONALD has returned to Los Angeles from Zacatecas, Mexico.

J. B. TYRRELL has been nominated for the presidency of the Canadian Mining Institute.

J. MORGAN CLEMENTS passed through San Francisco on his return from China to New York.

R. S. BURDETTE is Captain in the Ordnance Reserve Corps and is stationed at Washington.

ROBERT S. LEWIS passed through San Francisco on his return from Palo Alto to Salt Lake City.

L. D. RICKETTS leaves Santa Barbara on the 12th inst. to make a tour of inspection in Arizona.

M. R. HULL, mechanical engineer to the Sissert company in Russia, has returned to New York.

H. C. DUDLEY has been appointed Captain in the 36th Regiment of Engineers and has closed his office at Duluth.

ARTHUR P. WATT has resigned as metallurgist to the Missouri Metals Corporation and opened offices as consultant at 52 Vanderbilt Ave., New York.

ARTHUR J. HOSKIN has resigned as editor of 'The Mining American,' and has resumed professional practice at 717 Cooper Bdg., Denver.

F. W. TRAPHAGEN, formely professor of metallurgy in the Colorado School of Mines, is now professor in the Dakota School of Mines.

B. MAGNUS has been visiting the zinc and lead plants of the American Metal Co. in Oklahoma and Colorado for the past month, and will visit smelters in Utah, California, Canada, and Montana this month, returning to New York early in February.

R. L. CHASE, of Edwin E. Chase & Son, Denver, has prepared a mining and geological map of Colorado that can be recommended to engineers, especially those coming to Colorado from the outside. The map is compact, 21 by 29 inches; it portrays the geologic structure in vivid colors and in a broad way, omitting subdivisions of geologic periods. The coloring is done by hand. Price $3.50. For sale by Mr. Chase at 1028 First National Bank Bdg., Denver.

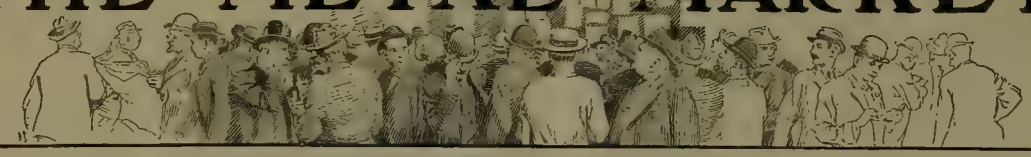
Obituary

WILLIAM HAGUE, Lieutenant in the 116th Regiment of Engineers, died of bronchial pneumonia on January 3 in France. He graduated from Harvard in 1904 and therefore was about 35 years old. The only son of the late James D. Hague, he followed worthily in his distinguished father's footsteps and had already given more than a promise of being an unusually capable and useful man. As soon as war was declared he volunteered for active service and went to the training camp, resigning his position as managing director for the North Star Mines company at Grass Valley. A man of high character and fine ideals, we record his untimely death with infinite regret, tempered by the recognition of the fact that he gave his life to the supreme call of manhood. He leaves a wife and little son.

Prices of Chemicals at the End of 1917

Acetate of lead, brown, per lb	15⅝—16 c.
Acetate of lead, white cryst., per lb	16½—17½c.
Acetate of lime, per 100 lb	$6.00—6.05
Alum, lump ammonia, per lb	4 — 4½c.
Alum, lump potash, per lb	18 —19 c.
Alum, chrome-ammonia, per lb	22½—23½c.
Aluminum hydrate, per lb	10 —11 c.
Aqua ammonia, 18°, in carboys, per lb	11½—13 c.
Aqua ammonia, 20°, per lb	12 —14 c.
Aqua ammonia, 22°, per lb	17 —18½c.
Arsenate of lead, paste, per lb	15 —17 c.
Arsenate of lead, powdered, per lb	31 —35 c.
Arsenic, per lb	16 c.
Barium chloride, prime, per ton	$80.00—90.00
Bi-carbonate of soda, per lb	2½— 2¾c.
Bleaching powder, in drums, per lb	2½— 3 c.
Blue vitriol, 99% cryst., per lb	9½—10 c.
Blue vitriol, 90–92% cryst., per lb	9 — 9½c.
Brimstone, at the mine, per long ton	$30.00—40.00
Calcium chloride, per ton	$21.00—22.00
Carbon tetra-chloride, per lb	15½—17 c.
Carbonate of potash, 96–98%, per lb	65 —80 c.
Carbonate of potash, 60–65%, per lb	47½—57½c.
Carbonate of zinc, per lb	22 —25 c.
Caustic potash, 88–92%, per lb	84 —85 c.
Caustic potash, 70–75%, per lb	64 —65 c.
Caustic soda, 76–78%, per lb	6.7— 7 c.
Chlorate of potash, imported Japanese, per lb	42 c.
Chlorate of potash, domestic, per lb	45 —53 c.
Chlorate of soda, per lb	24½—25½c.
Chloride of ammonia, lump sal ammoniac, per lb	17 —19 c.
Chlorine gas, liquid, per lb	14 —16 c.
Copperas, per lb	1 — 1½c.
Cyanide of soda, per lb	37 —53 c.
Glauber's salt, per 100 lb	$1.00
Nickel salts, per lb	13 —15 c.
Sal soda, per lb	1.15—1.35c.
Salt cake, refined, per ton	$30.00—35.00
Salt cake, crude, per ton	$25.00—26.00
Saltpetre, per lb	28 —28½c.
Silicate of soda, 60°, per lb	3½— 4 c.
Silicate of soda, 40°, per lb	1⅞— 2 c.
Soda ash, per lb	2.85— 3.2c.
Sulphate of alumina, commercial, per lb	2 — 3 c.
Sulphate of alumina, iron free, per lb	3 — 4 c.
Sulphate of zinc, per lb	6 — 7 c.
Sulphide of soda, 60%, fused, per lb	4 — 4½c.
Sulphide of soda, 30%, cryst., per lb	2¾— 3¼c.
Tin oxide, per lb	85 c.
Acid, acetic, 28%, per lb	5½— 7 c.
Acetic, glacial, 99%, per lb	34 —40 c.
Cresylic, 95–97%, per gal	$1.10— 1.15
Hydrochloric, per lb	8 — 8½c.
Lactic, 22°, per lb	5½— 6½c.
Nitric, 42°, per lb	8½— 9½c.
Oxalic, per lb	45 —40 c.
Phosphoric, 85%, per lb	35 c.
Phosphoric, 50%, per lb	26 c.
Sulphuric, 66°, per ton	$28.00
Sulphuric, 60°, per ton	$18.00
Tannic, U. S. P., per lb	$1.30— 1.40
Tannic, technical, per lb	50 —70 c.
Tartaric, cryst., per lb	76 —78½c.
Tartaric, powd., per lb	77 —78 c.

THE METAL MARKET



METAL PRICES

San Francisco, January 8

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.95
Antimony, cents per pound	17.00
Antimony (wholesale), cents per pound	15.25
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67½
Pig-lead, cents per pound	6.50— 7.50
Platinum, soft and hard metal, respectively, per ounce	$105— 113
Quicksilver, per flask of 75 lb	115
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	20

ORE PRICES

San Francisco, January 8

Antimony, 45% metal, per unit	$1.00
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.70— 0.85
Magnesite, crude, per ton	$8.00—10.00

There is little demand for either calcined or crude magnesite.

Manganese: The Eastern manganese market continues fairly strong with $1 per unit Mn quoted on the basis of 48% material.

Tungsten, 60% WO_3, per unit	26.00

Tungsten ore is firm, all the stock in New York has been exhausted.

Molybdenite, per unit MoS_2	$40.00—45.00

EASTERN METAL MARKET

(By wire from New York)

January 8.—Copper is quiet and unchanged at 23.50c. all week. Lead is firm and higher at 6.50 to 6.70c. Zinc is dull and steady at 7.87c. all week. Platinum remains unchanged at $105 for soft metal and $113 for hard.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Jan.	2	Nov. 27	84.60
"	3	Dec. 4	84.70
"	4	" 11	85.70
"	5	" 18	85.38
"	6 Sunday	" 25	86.42
"	7	Jan. 1	86.62
"	8	" 8	88.66

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	48.85	56.76	75.14	July	47.52	63.06	78.92
Feb.	48.45	56.74	77.54	Aug.	47.11	66.07	85.40
Mch.	50.61	57.89	74.13	Sept.	48.77	68.51	100.73
Apr.	50.25	64.37	72.51	Oct.	49.40	67.86	87.38
May	49.87	74.27	74.61	Nov.	51.88	71.60	85.97
June	49.03	65.04	76.44	Dec.	55.34	75.70	85.97

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Jan.	2	Nov. 27	23.50
"	3	Dec. 4	23.50
"	4	" 11	23.50
"	5	" 18	23.50
"	6 Sunday	" 25	23.50
"	7	Jan. 1	23.50
"	8	" 8	23.50

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	13.60	24.30	29.53	July	19.09	25.66	29.67
Feb.	14.38	26.62	34.57	Aug.	17.27	27.03	27.42
Mch.	14.80	26.65	36.00	Sept.	17.69	28.28	25.11
Apr.	16.64	28.02	33.16	Oct.	17.90	28.50	23.50
May	18.71	29.02	31.60	Nov.	18.88	31.95	23.50
June	19.75	27.47	32.57	Dec.	20.67	32.89	23.50

A conservative estimate of the Lake Superior copper production for 1917 is 230,000,000 lb. Ahmeek, Isle Royale, and La Salle alone show increases.

TIN

Prices in New York, in cents per pound.

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	34.40	41.76	44.10	July	37.38	38.37	62.60
Feb.	37.23	42.60	51.47	Aug.	34.37	38.88	62.53
Mch.	48.76	50.50	54.27	Sept.	33.12	36.66	61.54
Apr.	48.25	51.49	55.63	Oct.	33.00	41.10	62.24
May	39.28	49.10	63.21	Nov.	39.50	44.12	74.18
June	40.26	42.07	61.93	Dec.	38.71	42.55	85.00

No tin is being offered on spot New York except a small quantity of Banca tin at about 84c. Chinese No. 1 en route, November shipment from China, is held at about 65c., December shipment is held at about 62c., January shipment 60.25 to 60.50 cents.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Jan.	2	Nov. 27	6.50
"	3	Dec. 4	6.50
"	4	" 11	6.50
"	5	" 18	6.50
"	6 Sunday	" 25	6.46
"	7	Jan. 1	6.50
"	8	" 8	6.65

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	3.73	5.95	7.64	July	5.59	6.40	10.93
Feb.	3.83	6.23	9.01	Aug.	4.62	6.28	10.75
Mch.	4.04	7.26	10.07	Sept.	4.62	6.86	9.07
Apr.	4.21	7.70	9.38	Oct.	4.62	7.02	6.97
May	4.24	7.38	10.29	Nov.	5.15	7.07	6.38
June	5.75	6.88	11.74	Dec.	5.34	7.55	6.49

The Joplin lead-ore market has shown greater strength and the purchases made have been extremely heavy, reaching such proportions as to absorb practically two-thirds of the surplus stock now held in the district. While all of this surplus is not moved, it is believed that now the lead surplus has been reduced to 2000 to 2500 tons now unsold. With the present conditions of the roads it is not believed that all purchases will be loaded out under 15 to 30 days. The base price for the major portion of the ores sold is $75 per ton.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Jan.	2	Nov. 27	8.00
"	3	Dec. 4	8.00
"	4	" 11	7.91
"	5	" 18	7.75
"	6 Sunday	" 25	7.75
"	7	Jan. 1	7.87
"	8	" 8	7.87

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	6.30	18.21	9.75	July	20.54	9.90	8.98
Feb.	9.05	19.99	10.45	Aug.	14.17	9.03	8.58
Mch.	8.40	18.40	10.78	Sept.	14.14	9.18	8.33
Apr.	9.78	18.62	10.20	Oct.	14.05	9.92	8.32
May	17.03	16.01	9.41	Nov.	17.20	11.81	7.76
June	22.20	12.85	9.63	Dec.	16.75	11.26	7.84

A committee has been appointed by the South Western Mining Safety and Sanitation Association of Webb City, Missouri, to investigate the possibilities of substituting spelter for copper, tin, and other metals for various purposes. Movements are on foot to interest capital in the building of a zinc-rolling mill. The price of sheet zinc has been for a long time ruling at much higher than the normal cost of producing sheet zinc, on account of there being only two producers of this material. It is believed that the use of sheet zinc could be enormously increased if the price of the sheet metal were more moderate.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending

Date		Date	
Dec.	11 115.00	Dec.	25 115.00
"	18 115.00	Jan.	1 130.00
		"	8 130.00

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	51.90	222.00	81.00	July	95.00	81.20	102 00
Feb.	60.00	295.00	126.25	Aug.	93.75	74.50	115.00
Mch.	78.00	219.00	113.75	Sept.	91.00	75 00	112.00
Apr.	77.50	141.60	114.50	Oct.	92.90	78.20	102.00
May	75.00	90.00	104.00	Nov.	101 50	79 50	102.50
June	90 00	74.70	85.50	Dec.	123.00	80.00	117.42

Samuel Montagu & Co. says: An advance specimen of the one rupee note has been received in India from the India Office in London. The note measures five inches by three and a half inches, and has an engraving of the head of the King Emperor in the left-hand top corner, similar to that on the silver rupee. There is a pink medallion in the centre of the note, across which the phrase 'One Rupee' is printed, while the numeral '1' is printed in opposite corners so as to facilitate counting. The Indian mints have been engaged in turning out munitions for the supply and transport corps and other divisions; the advantage, therefore, of lessening their duties, by the issue of small notes instead of coins, is obvious. Notwithstanding their special activities in munitions, the mints turned out in 1916-17 R. 207,737,326 in silver coin, as against R. 16,202,199 in the previous year.

Mining companies are requested to advise us of new dividends declared and to furnish complete figures for dividend disbursements made during the year 1917, in order that our monthly dividend-list may be kept up to date.

Eastern Metal Market

January 2.

The markets are all decidedly quiet as the new year begins. The last week in the old year has been probably the quietest of all, as is usually the case.

Copper at controlled prices is moderately active.

Tin continues alarmingly scarce, and high, at nominal prices.

Lead is dull but firm.

Zinc has a better tone but is inactive.

Antimony is quiet.

In the steel trade the announcement has been made by the President that the present schedule of fixed prices will continue in effect three months longer, and that an agreement has been entered into whereby, on contracts made in the coming three months, prices would be revised in deliveries after April 1, 1918, to conform to any changes that might become effective on that date. Possibly 100,000 cars may be ordered for its railroads by the Government, now that it has taken control of them. Additions to the steel capacity of the country in 1917 were larger than expected. There were 97 new open-hearth furnaces completed in 1917, with an estimated capacity for producing 4,326,500 gross tons of steel ingots. The Steel Corporation furnished 1,220,000 tons of this total. The increase in 1917 was 4,205,000 tons, so that 1917 constitutes a record. New blast-furnaces blown in during 1917 were 14, with an annual capacity of 2,520,000 tons, against only five new furnaces in 1916. Sixteen more are now under construction.

COPPER

The copper market begins a new year in a decidedly stabilized and apparently comfortable and satisfactory condition. This has been true for some time, and is due to Government regulation of prices and distribution. It is apparently a settled fact that there will be no change in prices for a considerable period; at least no reduction will be made, and the trade feels that it can proceed safely and freely for a while. Sales are being made regularly to the trade, with Government and Allied needs having the priority at the established price of 23.50c. per lb. for carload lots or more, and at 24.67½c. for less than carloads and for delivery in the first quarter. Many in the trade have reason to believe that the supply of copper will be sufficient to cover all reasonable needs. It is also stated that the producers have on their books orders for the Government's requirements for the next six months. The fuel question may result in some lessening of activity among consumers using copper for non-essential purposes, but this may not prove a big factor in lessening consumption. December exports seem likely to have been larger than the November, which were 38,638 gross tons. The total for 1917 to December 1 was 448,596 tons, against 327,310 tons for the whole of 1916. The monthly exports have been 40,781 tons to December 1. For several months the London market has been unchanged at £125 per ton for spot electrolytic.

TIN

Tin of all grades continues scarce, and the market, as the new year enters, is nominally higher than at any time in its history. In this district it is nominal at 85 to 86c., New York, for spot Straits with other grades correspondingly high. No metal is being offered for spot delivery except a little Banca tin at about 84c. The British government has apparently taken some important action, the details of which are lacking so far. It appears probable that all speculation in the metal has been forbidden and that sales in that country will be permitted only for consumers' requirements. It also probably means that the American consumers' names will not have to be passed upon by the London Tin Committee, leaving consumption entirely to the American Iron and Steel Institute. It is probable that the result of this action will be to insure more adequate supplies to this country, as well as the elimination of permits with their difficulties and delays. Arrivals of tin to December 27 were 1705 tons, with 4400 tons afloat. The last cable from England, on December 28, showed spot Straits at £295 per ton, which compares with £309 10s. on December 21, a decline of £13 10s.

LEAD

The firmness which has characterized the lead market for many weeks still rules as the new year opens, and prices are at unchanged levels. The quotation for early delivery in the outside market is 6.50c., New York, or 6.35c., St. Louis, with the leading interest asking 6.25c., New York. The market is only moderately active, with a fair-sized demand during the past week for lots varying from carloads to 100 tons. There seems to be no trading in large volume. The industry was free from price-fixing in 1917, but it will be imposed in 1918 if a runaway market develops, of which there seems little prospect now. A lesson in this was learned in 1917. The preliminary estimate of the 1917 lead output by the U. S. Geological Survey is expected soon, and it is awaited with interest. Some put the total at 625,000 tons, against 571,134 tons in 1916 and 550,055 tons in 1915. The output in the first half of 1917 was 306,062 tons and it has probably been heavier in the last half.

ZINC

A slightly better tone pervades the market at the beginning of the new year but the market is practically at a standstill, with no desire by buyers to buy nor by sellers to sell. The cause of these conditions is probably the high bids on the Navy's 1000 tons of grade C zinc, and the probably similar bids on the 4000 tons of the same material for the Army, though these are not known as yet. It is stated that only a few producers offered bids on the latter order. It is felt also that this fairly large interest in the market on the part of the Government is a forerunner of more buying of other grades. Irregularity as to quotations on prime Western for early delivery characterizes the situation. Some ask as high as 8c., St Louis, but the market is probably quotable at 7.62½c., St. Louis, or 7.87½c., New York, at which a few small sales have been made. The year 1917 has not been altogether an unsatisfactory one, and the new year begins with prices only a little above the lowest level of 1917.

ANTIMONY

Late last week a consumer made inquiry for a fairly large amount for prompt delivery, on which later it is understood some fairly low quotations were made. The prices are therefore easier at 14.50 to 14.75c. per lb., New York, duty paid, for Chinese and Japanese grades for prompt delivery. War demand is more uncertain than ever for our own needs in particular.

ALUMINUM

There is no interest in aluminum and No. 1 virgin metal, 98 to 99% pure, is unchanged at 36 to 38c. per lb., New York, for early delivery.

ORES

Tungsten: There is very little news. The market continues strong after the demand noted last week with 60% concentrates selling at $24.50 per unit for wolframite, and $26 per unit for scheelite. Ferro-tungsten is quiet at unchanged prices.

Dividends From Mines, United States and Canada

Company	Metal	Shares issued	Par value	Paid in current year	Total to date	Latest dividends Date	Amount
Ahmeek Mining Co., Michigan	copper	200,000	$25.00	$2,400,000	$8,450,000	July 10, 1917	$4.00
Alaska Treadwell, Alaska	gold	200,000	25.00	none	15,785,000	May 28, 1916	0.50
Allouez, Michigan	copper	100,000	25.00	900,000	1,700,000	July 3, 1917	3.00
Anaconda, Montana	copper	2,331,250	50.00	4,662,500	122,554,375	Feb. 26, 1917	2.00
Arizona Copper Co., Ltd.	copper	1,519,896	1.22	1,777,408	22,645,834	July 31, 1917	0.55
Atlantic, Michigan	copper	100,000	25.00	.....	990,000	Feb. 21, 1905	0.50
Barnes-King, Michigan	gold	40,000	5.00	30,000	60,000	June 1, 1916	0.07½
Brunswick Con., California	gold	395,287	1.00	23,717	203,315	Sept. 15, 1917	0.06
Bunker Hill & Sullivan, Idaho	lead	327,000	10.00	490,500	18,980,250	Mar. 3, 1917	0.50
Caledonia, Idaho	l.s.c.	2,605,000	1.00	234,450	2,678,941	Oct. 5, 1917	0.03
Calumet & Hecla, Michigan	copper	100,000	25.00	7,500,000	139,250,000	Mar. 22, 1917	25.00
Cardiff, Utah	s.l.	500,000	5.00	375,000	500,000	Dec. 1916	0.25
Centennial C. M. Co., Michigan	.....	90,000	25.00	90,000	180,000	Mar. 20, 1917	1.00
Cerro Gordo, California	l.s.z.	1,000,000	1.00	175,000	175,000	Oct. 15, 1917	0.05
Champion, Michigan	copper	100,000	25.00	6,014,541	17,514,541	Nov. 14, 1916	6.40
Chief Con., Utah	.....	884,020	1.00	44,201	576,719	Feb. 5, 1917	0.05
Chino Copper, New Mexico	copper	869,980	5.00	7,177,335	13,875,330	Dec. 31, 1916	3.00
Continental Zinc Co., Missouri	zinc	22,000	5.00	22,000	385,000	July 2, 1917	0.50
Con. Arizona, Maine	.....	1,663,000	5.00	83,150	.....	Aug. 15, 1917	0.05
Cresson Con., Colorado	gold	1,220,000	1.00	1,098,000	5,331,362	Oct. 10, 1917	0.10
Dome Mines Co., Ltd., Ontario	silver	400,000	10.00	300,000	1,500,000	June 1, 1917	0.25
Dragon Consolidated, Utah	.....	1,875,000	1.00	56,250	56,250	July 25, 1917	0.01
Eagle & Blue Bell, Utah	.....	893,146	1.00	.....	535,888	Dec. 28, 1916	0.05
East Butte C. Co., Montana	copper	411,000	10.00	411,000	411,000	Jan. 29, 1917	1.00
Electric Point M. Co., Washington	.....	793,750	1.00	166,688	166,688	Sept. 30, 1917	0.15
Federal Mining Co., Idaho	.....	60,000	100.00	.....	2,705,335	Jan. 15, 1909	1.50
Fremont Con., California	gold	200,000	2.50	12,000	280,000	Mar. 20, 1917	0.02
General Development Co., New York	.....	120,000	25.00	720,000	4,293,917	Sept. 1, 1917	2.00
Good Springs Anchor, Nevada	z.s.	550,000	1.00	16,500	158,285	Mar. 15, 1917	0.01
Golden Cycle M. & R. Colorado	gold	1,500,000	1.00	450,000	8,088,500	Oct. 10, 1917	0.03
Goldfield Consolidated, Colorado	gold	3,559,148	10.00	none	28,999,831	Oct. 30, 1915	0.10
Granite G. M. Co., Colorado	gold	1,650,000	1.00	33,000	319,500	Sept. 1, 1917	0.01
Hecla Mining Co., Idaho	s.l.	1,000,000	0.25	1,600,000	6,905,000	Dec. 1917	0.05
Hedley Gold M. Co., Hedley, B. C.	gold	120,000	10.00	240,000	3,231,191	Dec. 1917	0.50
Hollinger Consolidated, Ontario	.....	4,920,000	5.00	738,000	8,194,000	Apr. 23, 1917	0.05
Hope Mines, Utah	.....	482,260	1.00	.....	4,697	Dec. 4, 1915	0.01
Inspiration Consolidated, Arizona	copper	1,181,967	20.00	7,387,294	13,571,410	July 30, 1917	2.00
Iron Blossom, Utah	l.s.g.	1,000,000	0.10	200,000	3,050,000	July 25, 1917	0.05
Iron Cap, Arizona	copper	145,039	10.00	20,459	.....	Jan. 1, 1917	0.20
Iron Silver, Colorado	.....	500,000	20.00	.....	5,150,000	Dec. 31, 1916	0.10
Isabella Mines, Colorado	gold	2,528,331	1.00	.....	767,783	Dec. 30, 1916	0.01
Isle Royale Copper, Michigan	copper	150,000	25.00	750,000	1,350,000	July 31, 1917	1.50
Jim Butler, Nevada	.....	1,718,021	1.00	171,802	687,208	Feb. 1, 1917	0.10
Judge M. & S. Co., Utah	.....	480,000	1.00	240,000	1,830,000	July 1, 1917	0.25
Jumbo Extension, Nevada	.....	1,550,000	1.00	77,500	.....	June 30, 1916	0.05
Kennecott Copper Corp., Alaska	copper	2,786,856	no par value	6,827,926	22,148,209*	June 30, 1917	1.50
Kerr Lake M. Co., Ontario	silver	600,000	5.00	450,000	7,170,000	Sept. 15, 1917	0.25
Liberty Bell, Colorado	gold	133,551	5.00	106,841	2,100,028	June 30, 1917	0.20
Lower Mammoth, Utah	.....	1,000,000	1.00	.....	67,000	Dec. 15, 1915	0.01
Magma Copper Co., Arizona	copper	240,000	5.00	384,000	1,104,000	Sept. 29, 1917	0.50
Mammoth Mining Co., Utah	g.s.c.	400,000	0.10	.....	2,420,000	Dec. 20, 1916	0.10
Mary McKinney, Colorado	gold	1,309,252	1.00	.....	1,182,398	Oct. 26, 1916	0.01
Mary Murphy, Colorado	g.s.l.z.	370,000	5.00	25,067	93,106	May 1, 1916	0.07
Mass Con. M. Co., Michigan	copper	100,000	25.00	300,000	500,000	Aug. 15, 1917	1.00
May Day, Utah	.....	800,000	0.25	56,000	300,000	Dec. 23, 1916	0.02
McIntyre-Porcupine, Toronto	.....	3,610,283	1.00	541,542	.....	Sept. 29, 1917	0.05
Miami Copper Co., Utah	copper	747,114	5.00	5,229,798	14,925,582	Aug. 15, 1917	2.50
Mogollon Mines Co., New Mexico	g.s.	355,882	5.00	none	173,352	Oct. 1915	0.05
Mohawk, Michigan	copper	100,000	25.00	1,700,000	5,575,000	Aug. 1916	10.00
Moscow M. & M. Co., Utah	s.l.c.z.	900,000	1.00	40,500	107,980	Aug. 1917	0.02
Nat. Zinc & Lead, Missouri	z.l.	500,000	1.00	20,000	210,000	May 15, 1917	0 02
Nevada Consolidated, Nevada	copper	1,999,457	5.00	4,298,832	34,772,065	Sept. 29, 1917	0.50
Nevada Hills, Nevada	gold	1,065,687	5.00	159,853	586,128	Aug. 28, 1917	0.05
Nevada Packard Mines	silver	1,250,000	1.00	.....	62,500	Dec. 2, 1916	0.05
Nevada Wonder, Nevada	.....	1,408,409	1.00	.....	915,205	Nov. 21, 1916	0.10
New Idria, California	quicksilver	100,000	5.00	100,000	2,330,000	Mar. 31, 1917	1.00
Nipissing Mines Co., Ontario	silver	1,200,000	5.00	600,000	600,000	Oct. 20, 1917	0.50
North Butte, Montana	c.g.s.	430,000	15.00	1,075,000	14,227,000	Jan. 29, 1917	0.75
North Star, California	gold	250,000	10.00	.....	5,087,040	Dec. 1916	0.50
Optimo Mining Co., Wisconsin	zinc	500	100.00	.....	40,000	Sept. 1915	0.05
Osceola Con. M. Co.	.....	96,150	25.00	1,730,000	16,217,975	July 31, 1917	6.00
Phelps-Dodge Corp., New York	.....	450,000	100.00	9,900,000	.....	Sept. 28, 1917	8.00
Pittsburgh-Idaho, Idaho	lead	821,306	1.00	65,524	364,389	Apr. 14, 1917	0.03
Plymouth Con., California	gold	240,000	4.87	115,200	350,640	Aug. 14, 1917	0.24
Portland Gold M. Co., Colorado	gold	3,000,000	1.00	90,000	10,687,080	Jan. 20, 1917	0.03
Prince Consolidated, Nevada	s.l.	1,000,000	2.00	50,000	425,000	Dec. 23, 1916	0.05
Quincy Mining Co., Michigan	.....	110,000	25.00	1,100,000	25,187,500	Sept. 24, 1917	5 00
Ray Consolidated, Arizona	copper	1,577,179	10.00	3,469,793	10,823,714	Sept. 30, 1917	1.00
Richmond M.M.& Red. Co., Washington	.....	84,000	1.00	84,000	84,000	Oct. 5, 1917	0.02
Rico Wellington, Colorado	.....	1,000,000	0.10	39,600	39,600	July 25, 1917	0.04
Round Mountain, Nevada	gold	1,320,630	1.00	.....	363,965	Aug. 1913	0.04
Shannon Copper Co., Arizona	copper	300,000	10.00	150,000	1,050,000	Feb. 15, 1917	0.50
Shattuck Arizona, Arizona	copper	350,000	10.00	875,000	5,512,500	Apr. 20, 1917	1.25
Silver King Coalition, Utah	.....	1,250,000	5.00	750,000	14,709,885	Apr. 1, 1917	0.15
Silver King Con., Utah	.....	700,000	1.00	313,287	1,422,705	Oct. 1, 1917	0.15
St. Joseph Lead, Missouri	lead	1,409,466	10.00	704,733	12,382,097	June 20, 1917	0.25
St. Mary's Mineral, Michigan	.....	160,000	25.00	1,920,000	.....	Aug. 30, 1917	2.00
Stratton Cripple Creek, Colorado	.....	20,000,000	0.50	.....	445,000	Feb. 1915	0.14
Superior Copper Co., Michigan	copper	100,000	25.00	100,000	200,000	Apr. 30, 1917	1.00
Temiscaming Mining Co., Toronto	silver	2,500,000	1.00	300,000	2,000,000	Oct. 24, 1917	0.03
Tonopah Belmont, Nevada	gold	1,500,000	1.00	187,504	8,580,540	Jan. 1, 1917	0.12½
Tonopah Extension, Nevada	g.s.	1,282,801	1.00	320,692	1,912,412	Apr. 2, 1917	0.10
Trethewey Silver Cobalt, Toronto	silver	1,000,000	1.00	50,000	1,161,998	Aug. 31, 1917	0.05
Uncle Sam Con., Utah	silver	750,000	1.00	.....	470,000	Sept. 20, 1911	0.05
Union Basin M. Co., Arizona	zinc	83,535	0.70	4 177	292,372	May 4, 1917	0.05
United Eastern M. Co., Arizona	.....	1,363,000	1.00	272,600	272,600	Oct. 26, 1917	0.05
United Verde, Arizona	copper	300,000	10.00	300,000	1,350,000	Mar. 1, 1917	1.50
United Verde Extension, Arizona	copper	1,050,000	0.50	.....	3,255,000	Aug. 1, 1917	0.85
Utah Apex Mining Co., Utah	s.l.	528,200	5.00	132,050	604,225	Jan. 2, 1917	0.25
Utah Consolidated, Utah	copper	300,000	5.00	900,000	11,175,000	Sept. 25, 1917	1.00
Utah Copper Co., Utah	copper	1,624,490	10.00	19,493,880	52,215,777	Dec. 31, 1917	3.50
Utah Metal & Tunnel, Utah	.....	691,588	1.00	345,794	688,266	Feb. 15, 1917	0.50
Utah-Missouri, Utah	zinc	10,000	1.00	52,000	62,000	Sept. 18, 1917	2.20
U. S. Smelting, Refg. & M. Co.	.....	351,115	50.00	1,728,900	27,480,292	Apr. 14, 1917	1.25
Vindicator Con., Colorado	gold	1,500,000	1.00	45,000	3,622,500	July 25, 1917	0.03
Wasp No. 2, South Dakota	gold	500,000	1.00	.....	649,465	May 15, 1916	0.02½
Wellington Mines Colorado	l.z.	1,000,000	1.00	200,000	1,450,000	Apr. 7, 1917	0.20
West End Con., Nevada	.....	2,000,000	5.00	100,000	700,000	Oct. 24, 1916	0.05
White Knob Copper, California	gold	400,000	10.00	60,000	245,000	Aug. 25, 1917	0.10
Wilbert M. Co., Idaho	.....	1,000,000	1.00	10,000	70,000	May 15, 1917	0.01
Wisconsin Zinc, Wisconsin	zinc	925,000	1.00	20,000	80,000	Mar. 1, 1917	0.02
Wolverine & Arizona, Michigan	copper	118,674	10.00	none	53,403	Dec. 15, 1915	0.25
Yak M. M. & T., Colorado	.....	1,000,000	1.00	70,000	2,837,685	Mar. 31, 1917	0.07
Yellow Aster M. Co., California	gold	1,032,100	1.00	35,000	1,245,789	July 20, 1917	0.15
Yellow Pine M. Co., Nevada	z.l.s.	1,000,000	1.00	90,000	1,753,008	Mar. 31, 1917	0.03

Abmreviations: g = gold, s = silver, c = copper, l = lead, z = zinc.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. *In current year additional dividend in stock, $2,090,239.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

CALOL ASPHALTUM IN PAVEMENT CONSTRUCTION

This is the title of a bulletin, No. 8, of the Department of Asphaltum of the Standard Oil Co. of California. We have made reference to it before, and have intimated that the brief statement it contains in regard to the properties and use of asphaltum is based upon an elaborate investigation, both physical and chemical, by a scientific staff of very high calibre. No more thorough research-work has been done anywhere in America than has been conducted during the last few years in the splendid research laboratories of the Standard Oil Company of California. The pamphlet constitutes a safe and practical handbook for the road builder and contractor, giving sufficient details of the mechanism and equipment needed for the business, accompanied with abundant illustrations, and supplying practical instructions in regard to the making of the mixtures adapted to different classes of service, erection of plant, lay-out of plant, and many similar points. It is particularly explicit in regard to the necessary equipment, such as elevators, conveyors, driers, screens for the aggregate, hot-storage bins, mixers, melting-tanks, pumping, asphaltum, and other matters of vital importance in the business. Finally, the company recommends, as a result of the elaborate tests that have been made with a view to obtaining from Californian oils a thoroughly reliable asphaltum for pavements, an article known as Calol asphaltum 'D' grade. This has the following characteristics:

Penetration, No. 2 needle, 100 gm., 5 sec., at 77°F., 40 to 90°.

Solubility in carbon disulphide (CS_2), not less than 99%.

Solubility in carbon tetrachloride (CCl_4), not less than 98.5%.

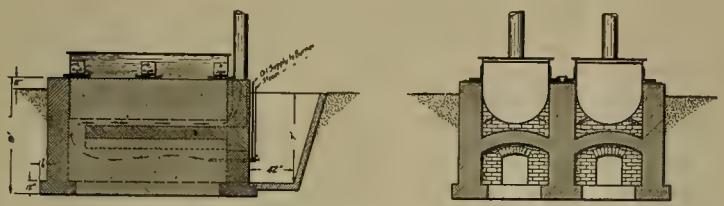
Ductility of a sample briquette, 1 sq. cm. in cross-section, elongated at 5 cm. per min. at 77°F., not less than 75 cm.

Evaporation from 50 gm. in 5 hr. at 325°F. in a dish 5.5 cm. (2⅛ in.) diam. and 3.5 cm. (1⅜ in.) deep, not more than 3%.

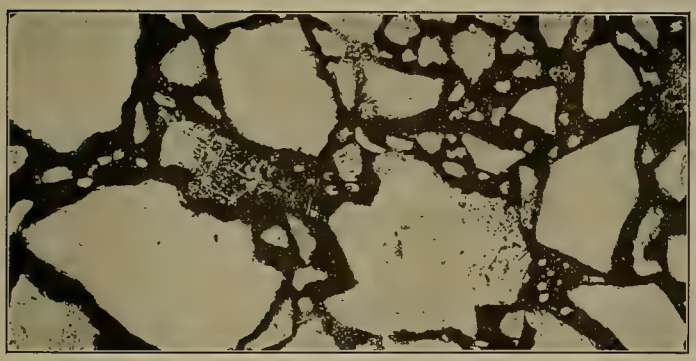
Penetration of sample after evaporation test, not less than 350°F.

Orders may be placed for Calol, asphaltum 'D' grade, with a range of 10° penetration, that is, from 40 to 50, 50 to 60, 60 to 70, 70 to 80, or 80 to 90, according to the choice of the engineer. It is shipped either in wood barrels or tank cars.

Details of tests for pavement materials occupy 25 pages in the pamphlet. These are in accordance with standard tests adopted by the U. S. Office of Public Roads, and the American Society for Testing Materials. The tests include hardness, resistance to wear, and toughness of rocks, together with cementing value of rock with water and with asphaltum, as well as the cementing values under compression. For asphaltum the consistence or penetration, and tests of solubility, ductility, volatilization, and also the flash tests are given. Accompanying these are descriptions of the modus operandi of the tests and illustrations of the equipment required. The book is accompanied with a classified index, both of subject matter and illustrations. It is a contribution of practical engineering literature that will be of great assistance to municipal and county officers, and to contractors everywhere having to do with the construction of paved streets and roads. It will also appeal to mine managers who have problems of surfacing roads for facilitating local haulage.



ASPHALTUM MELTING-TANKS



SECTION OF ASPHALTIC CONCRETE PAVEMENT

DECISION ON THE DEISTER PATENTS

The District Court of the United States for the District of Indiana has handed down a decree in equity, No. 201, in the case of Deister Machine Co. *v.* Deister Concentrator Co., holding valid and infringed certain claims in patents issued to Emil Deister and William F. Deister, as follows: claim 4 in Patent 1,040,164; claim 1 in Patent 1,040,165; and claims 1, 4, and 5 in Patent 1,088,685; and a perpetual injunction is issued against the defendant. Article 5 of the decision states the infringement as given below:

That the Deister Concentrator Company infringed upon claim 4 of said Letters Patent No. 1,040,164, viz: "4. A concentrating table having its main surface in a single plane and.

suitably inclined in combination with means for distributing material across the head of the table, riffles arranged at such an angle to the flow of material from the head as to divert the minerals toward the mineral discharge edge, a plateau having its surface above but substantially parallel with the general surface of the table and arranged with its inner edge at an angle less than ninety degrees to said riffle, and riffles extending across the plateau," upon claim 1 of said Letters Patent No. 1,040,165, viz: "1. A concentrating table inclined downwardly from its head and upwardly from its rear side, in combination with means for uniformly distributing the material to be treated across the upper end, riffles arranged transverse of the main surface of the table, and a plateau having its surface above but substantially parallel with the main surface, and arranged to intersect the line of movement of the material due to the vibrations of the table;" and upon claims 1, 4, and 5 of said Letters Patent No. 1,088,685, respectively, viz: "1. A concentrating table having in combination therewith a plurality of plateaus arranged transverse of the lines of movement of the values toward the mineral discharge edge, and having their surfaces higher than that of the main or stratifying surface and the surface of each succeeding plateau being higher than that of the preceding plateau, the front edge of the final plateau of the series forming the mineral discharge edge and a plateau or plateaus intermediate the main surface of the table and the last plateau being adapted to permit of a further stratification of the material and to deliver concentrates as a stratum to the plateau having the mineral discharge edge." "4. A concentrating table, having in combination therewith a plurality of plateaus arranged transverse of the lines of movement of the values toward the mineral discharge edge, the main or stratifying surface of the table and the surfaces of the plateaus being in different but parallel planes and the rear edges of the plateaus being beveled or inclined to facilitate the upward and onward movements of the values, the front edge of the final plateau of the series forming the mineral discharge edge and a plateau or plateaus intermediate the main surface of the table and the last plateau being adapted to permit of a further stratification of the material and to deliver concentrates as a stratum to the plateau having the mineral discharge edge." "5. A concentrating table, having in combination therewith a plurality of plateaus arranged transverse of the lines of movement of the values toward the mineral discharge edge and having their surfaces higher than that of the main or stratifying surface, and the surface of each succeeding plateau being higher than that of the preceding plateau, and riffles arranged on the main or stratifying surface and extending onto the plateau next adjacent to the mineral discharge edge, the front edge of the final plateau of the series forming the mineral discharge edge and a plateau or plateaus intermediate the main surface of the table and the last plateau being adapted to permit of a further stratification of the material and to deliver concentrates as a stratum to the plateau having the mineral discharge edge;" and upon the exclusive rights of the complainant under the same.

THE MONROE 'CALCULATING MACHINE' was given a well-deserved notice in our last issue, in an article written by R. M. Farmer. The facts will not be misconstrued by an understanding public, in view of the plain intent of the statement, despite an unfortunate error that crept into the printed page, twisting Mr. Farmer's affirmation as to operating speed into the exact reverse of the truth. Beginning with line 16, column 1, on page 30, the sentence should read: "It has been shown that the operating speed of a Monroe calculating machine is greatly in excess of that obtained by other methods, but the chance for inaccuracy has been brought to an irreducible minimum as well."

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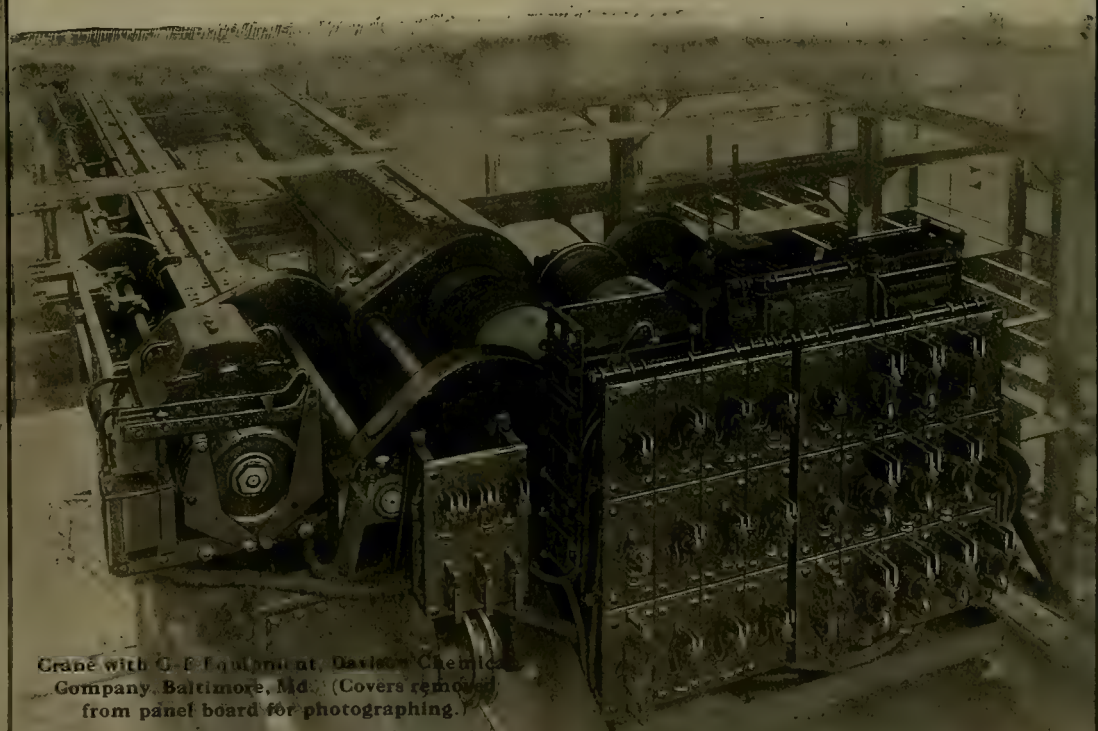
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EDITORIAL

THE 116th meeting of the Institute will be held at New York from February 18 to 21 inclusive. An interesting programme has been arranged.

GOLD production decreased in 1917. The Mint and the Geological Survey estimate the American output at $84,456,600, which is $8,130,000 less than in 1916 and the smallest total since 1904, when it was $80,464,700. The rest of the world is not likely to have compensated for this decline, but statistics are not yet available.

KEEN satisfaction has been expressed by the oilmen of California at the appointment of Mr. Mark L. Requa as head of the oil division of the Food Administration. He is to direct operations on the oilfields under Government control. Mr. Requa has had experience in the oil business and is thoroughly fitted for the task. We join with the mining profession in commending the appointment.

CARRANZA is said to be offering Clipperton island for sale to Japan. The Señor is usually more astute than that. He overlooks the fact that Viscount Ishii recently visited this country and obtained recognition of what the Japanese papers call "the Monroe Doctrine of the East." That balances a counter courtesy on the part of Japan, which means that the market for American islands is limited. If Mexico has any land for sale she had better call at Uncle Sam's real estate bureau.

OUR contemporary in London, 'The Mining Magazine,' is 'carrying on' with manifest vigor, despite the many hindrances due to the War. The issue for December, just to hand, is excellent, particularly in respect of the engineering drawings that accompany the article by Mr. J. Waring Partington, on the Taylor concentrator at the East Pool mine in Cornwall. Our compliments to Mr. Edward Walker and to Mr. W. F. White, the editor and managing director respectively.

AMERICA'S foreign commerce in 1917 amounted to $9,050,000,000, of which three billions only represented imports. In the last three years our foreign commerce has reached a total of $22,201,077,067, with an accumulated credit balance in our favor of $8,115,883,677, which is about equal to the total stock of gold in the world. In addition to this trade balance the United States government received authority from Congress to advance something over four billions of dollars to our Allies out of the war appropriation of 19 billions.

WHAT happens to a successful trade paper is illustrated by our friend the 'Iron Age,' whose first issue in January consists of 130 pages of reading matter and 718 pages of advertisements. The magazine is two inches thick and weighs 5½ pounds, the postage on which is 5½ cents and the cost of paper alone must be 27½ cents. It is a comprehensive directory of the iron and steel trade. The front cover carries a beautiful steel engraving, by the American Bank Note Company, whose handiwork on U. S. currency is so attractive to most of us.

ON another page we reproduce a contract offered by the Minerals Separation company for signature to a metallurgist that had invented an improvement in flotation. The text speaks for itself. Like the contract that the Minerals Separation people attempted to force upon metallurgists employed by their licensees, this is a rank bluff and an imposition upon the self-respect of a technical man. It will be noted that Minerals Separation consents to the use of apparatus by its licensees, and the inventor is to pay 10% of the selling price of the machine to Minerals Separation, and as against the privilege of paying 10%, the inventor is not allowed to sell his machine to anybody not licensed by Minerals Separation, on penalty of a fine of $10,000. It is to laugh! Fortunately, that is what the inventor did, sharing his sense of humor with us and our readers.

THE passing of Thomas L. Livermore removes a distinguished figure from the mining world. He was long the associate of Alexander Agassiz and Quincy A. Shaw, and was responsible for the general direction of America's most remarkable copper mine, the Calumet & Hecla. His force of character, and his exact and scrupulous observance of business propriety, made him a factor in the copper market and enabled him to throw his weight against the policies that at one time tended

strongly in the direction of large combinations to control the output of that metal. Colonel Livermore, acting in accord with his associates, held to the advantage of independence, thereby encouraging other important copper companies to resist the temptation toward amalgamation and restraint of trade. It is noteworthy that, of all the leading non-ferrous metals, copper has been most nearly free from pernicious capitalistic control. A contrary disposition on the part of Colonel Livermore might have altered completely the character of the copper industry, to the detriment of this country and of the world.

PROTESTS are being made by the American Mining Congress in behalf of the mining industry against the proposal to place the direct control of mining operations in the hands of the Government. Mr. M. D. Foster, of Illinois, chairman of the Committee on Mines and Mining, has introduced a bill providing for the control of mineral deposits by the President, similar to that provided for food and coal in the Food Act. This bill seeks to appropriate $150,000,000 for the purpose stated. The idea, it is said, is "to ensure an adequate and continuous supply of certain rare metals, such as tungsten, which are needed for war purposes." Surely such legislation is wholly unnecessary. Statistics demonstrate that the operators of mines are responding whole-heartedly to the call for the metals needed for munitions, and if further increase of production be necessary it can be effected by the assistance of the Bureau of Mines, the Geological Survey, and other agencies that exist to aid the mineral industry of the country. The first result of such an enactment would be to place a $1 halo on a number of prominent millionaires and cripple the industry with unnecessary red tape. Let the President say what metals are needed and they will be forthcoming, for the mining industry can furnish both the money and the men to do it without further legislation or the creation of more committees.

GERMANY had planned before the War to violate all manner of anti-trust principles and national prejudices throughout the world. We present demonstration of the Teutonic performance on another page. It resembles a spider's web, and was alluring as a market into which all were invited in language recalling the nursery jingle "Will you walk into my parlor"? Moreover, the unsuspecting world did walk in, and through this astonishing combination it became possible for Germany to absorb metallic products in preparation for war without exciting suspicion. Many reputable houses in the system were wholly unconscious of the use being made of them in furtherance of the gigantic plan for Germanic imperial dominance. They were found in a strong position in the world's markets, and it was deemed easier to absorb the advantage of that position by letting such firms make money in association with a German house whose distant 'metallbank' was invisible. The British are now thoroughly awake to the peril of again permitting such trade organizations as those created for the ultimate purpose of the Prussian machine, a purpose that we live to see frustrated. Apart from the national question it is clearly dangerous to permit any group in any country to control the metal market of the world to such an extent.

COMPARISON of metal prices during 1917 as against 1916 shows that the industry had good fortune:

	1917 Cents per pound	1916 Cents per pound
Copper	27.52	28.03
Lead	9.06	6.88
Zinc	9.18	13.70
Tin	61.56	43.26
Silver	81.23	65.66
Mercury per flask	106.33	126.89

The fixation of the price of copper at 23½ cents pulled down the average for the year, but not to a calamitous degree, owing to the higher prices ruling during the first eight months. The beginning of 1918 sees copper pegged again at 23½ cents, for word has come from Washington that the Federal authorities have continued the same price for another four months. The collapse of the spelter market has been the most untoward event of the year. Zinc is firm at 7.87 cents, which, however, represents a decided recession even from the 1917 average. The average price of lead in 1917 was being paid in September, but since then the decline has been serious, falling to 6½ cents during the closing quarter and beginning the new year at about that figure. We produce so little tin in this country that the price affects not the miner but the manufacturer, who has to import it. The silver market is strong at about 9 cents above the average for 1917 and the prospect is good for a slightly higher price when the proposed fixation has been consummated. Mercury is an important product of California, and it is pleasant to record a present price that is $24 per flask higher than the 1917 average. All that the miner can ask for 1918 is that the prices for copper, silver, and mercury may be maintained, and that those for lead and zinc should be raised a little, the prices of the latter being good as compared with the pre-war period but the increased cost of operation offsets the apparent advantage. On the whole, the mining industry is not suffering from the War.

Wildcats

The *felis rufus* of mining finance is an interesting animal, not only on account of the ravages he causes in well-lined pockets, but by reason of his variable temperament. He is not always predatory. The dictionary says that he is the expression of reckless or unsound finance. One definition says: "Originated or characterized by wild irresponsible speculation; unreliable or unsafe, by reason of reckless financiering." A nefarious motive is commonly assumed to be at the back of a feline project. In 'Yavapai,' a paper published at Prescott, we read the following comprehensive definition. "A wildcat mining company is one in which the management raises money,

often by exaggerated and misleading statements, intending to use the funds so raised for their personal profit, rather than for the development of the property, and without regard to securing an adequate return to investors." "Their profit" must refer to the organizers of the company, and "investors" is a euphemism for 'speculators.' Still it is a definition that would be generally acceptable. However, malign intent is not a necessary characteristic of the 'wildcat,' for that term is now used sometimes simply to indicate a long shot, the locating of claims far from points of actual discovery, the taking of a sportive risk in mining. We remember being threatened with a libel suit because we said that the Great Boulder Proprietary mine, in Western Australia, started life as a wildcat. To the lawyer that called upon us we explained how 'wildcat' was used in Nevada as a term for riskiness in which deception was not involved. We were reminded of the senator from Nevada who used an epithet that, according to Owen Wister in 'The Virginian,' must be accompanied by a smile lest it start gun-play; how a committee of senators was appointed to inquire into the scandalous incident; and how the colleague of the senator from Nevada testified that this opprobrious epithet, reflecting harshly upon another gentleman's pedigree, was used as a term of endearment at Virginia City; indeed, when a denizen of the Comstock returned from the Coast he was accosted with a slap on the shoulder and the polite inquiry, "How are you old —— of a ——!" *Se non è vero, è ben trovato.* That is what the English lawyer said when I tried to persuade him that 'wildcat' was almost a term of financial endearment. So, to avoid confusion and prevent imposition, as they say at Niagara Falls, it may be well to adopt a definition more like that of our contemporary at Prescott. He, of course, cocked an eye at Jerome, where wildcats breed like rabbits. If you apply the epithet 'wildcat' to any of the numerous enterprises having names that entwine the words, Great, Copper, Jerome, Verde, United, and Extension into a halo of romantic expectation, you will be asked indignantly if the United Verde Extension was not a 'wildcat' until it was proved a rich mine? Was it? It was a risky venture, without question; but it was a sane one, in which the amount of money risked was not disproportionate to the possible winning. Moreover, the men that subscribed the working-capital were able to lose their money without going bankrupt; they risked no more than they could afford to lose. The venture was started by an intelligent and experienced engineer, who paid for special geological advice and proceeded to explore in a scientific way. Even the earlier efforts, before Messrs. Douglas and Tener took the prospect in hand, were conducted intelligently; they were based on legitimate inferences and their organizers made no attempt to collect money "for their personal profit"; the money they raised was spent by experienced men in a systematic search for ore and in a locality in which ore was likely to be found. It may be said that this is wisdom after the event, and indeed the character of a wildcat can best be determined by its performance, for the motives behind human actions are difficult to prove. Unanimity of opinion concerning the various prospecting enterprises fostered by the astonishing success of the U. V. X. is not to be expected. A few are obviously legitimate ventures, a few are equally obviously hopeless, if not nefarious, but the larger number cannot be labeled with certainty. Those prospecting below the big fault at Jerome have a reasonable chance, but, if we may venture the opinion, those above are unlikely birds, as unlikely as a volant non-ruminating artiodactyle. The absence of evidence of ore is used by some of these almost as a favorable argument: "Look at the U. V. X." they say, "that had no ore to start with." They ignore the geologic structure and pin their faith on the happening of a miracle. That is not mining, that is 'wildcatting.'

More Competency Needed

The Government 'nitrate plant' at Muscle Shoals, Alabama, will begin producing fixed nitrogen from the air in the coming month of July. This affords a sense of heightened security. At the same time it should cause the public to reflect that the same officials that allowed themselves to be bamboozled by a group of talkative chemists and electricians, still remain in control at Washington and are responsible for duties in the serious business of getting this nation ready for war. Less than two months ago, nearly a year and a half after Congress had appropriated the funds necessary for building a great factory to make nitrogen products, a commission of engineers visited Muscle Shoals and made the final recommendations that construction be started at once. Perhaps the plant will be ready in six months, though we incline to doubt it. That would be quick work, which is one reason, though not an altogether defensible reason, for scepticism. One thing that intensifies the feeling of uncertainty is a rumor, which wandered over the wires and got into print in the newspapers, to the effect that the plant erected by the American Cyanamid Company at Sheffield, Alabama, was nearly ready and would soon be supplying the needs of the Government. In this confusion of the facts the public is sure to gain a wrong impression. Those in authority may claim that a manufacturing establishment is in fact "nearly ready," although it has just been started, when its completion is due in six months, but it is not stating the facts with proper regard to their true time relations, to put it as mildly as possible. Furthermore, this association of the name of the American Cyanamid Company with the matter obscures the issue. Either this is a democracy or it is not; if it is, then let us run the risks incident to democracies by confiding the truth to the people. The public, in a democracy, will learn the truth sooner or later, and if later the postponment will engender a lack of confidence that is like pouring sand into the bearings of a dynamo. We understand that the Government, after realizing that it confronted the peril of having no adequate and safe supply of nitrogen products available,

because it had been influenced by men who counseled delay under the guise of experimentation, and thereby served the cause of the Hohenzollern dynasty, suddenly decided to build a big plant, and selected a site that is above reproach. It is situated far in the interior; it is capable of easy protection from a military standpoint; and it has at command, from the rapids in the Tennessee river, a minimum of 680,000 horse-power, which can be developed. The American Cyanamid Company then came to the rescue with a corps of engineers possessing superior knowledge of the details needed for the enterprise. Their accumulated experience, their well-trained technical staff, their working drawings, all have been placed patriotically at the service of the Government. This corporation, therefore, stands among those to whom the country owes special gratitude. On the other hand, it is important to note that the water development cannot possibly be completed within another year, and that it is necessary to fall back upon 30,000 horse-power obtainable from the Alabama Power Company, and that an auxiliary 30,000 horse-power steam-plant will also be erected at the foot of the great shoals over which 23 times as much energy glides unharnessed and unused, and all this because there was no one in authority whose wisdom and judgment and sense of duty were large enough to protect the interests of the American people. It is no light matter to co-ordinate the many activities needful to urge forward our preparation effectively. We do not wonder that men fail in the attempt. We are not surprised at confusion of authority nor at some clogging of the wheels of administration. It takes time to find the men that can efficiently carry the vital responsibilities of war. France swept out ministry after ministry before Clemenceau was called to establish a government in which confidence could be reposed; England floundered through much impressive speech-making to the vigorous activity of Lloyd George. Meanwhile we still have Daniels and Baker and some others who might at least remove the doubt as to their superiority by giving someone else a chance to do better or worse. General Pershing has been swift to fit new human metal into his fighting machine in France in an effort to improve the service. It is an instructive object lesson. Incompetence will not do on the firing line. What then of incompetence behind the firing line? The world takes it as a matter of course that there is efficiency in Germany, while in our own country even the man on the street gossips of incompetency. Such a reproach upon American intelligence must be effaced, and one essential is to cease being tolerant toward officials and committees that are not achieving the results for which they were put in power. The action of President Wilson in taking control of the railway system was a display of firmness and decision that may mark a salutary change in our methods. It would seem that many of the war committees need to be re-constituted on a basis more consistent with democratic principles. The public has reason to distrust the disinterestedness of committees when composed of men who are the chief producers of the materials over which they hold authority for the Government. The metal-market has been embarrassed for months at a time by failure to declare firm policies that looked far enough into the future to admit of consistent plans for steady and economical production. For example, stagnation has afflicted the zinc industry because the prices have not been fixed and no indication has been given as to the probable requirements of the Government. Experience gained from the foreign demand before we entered the War led to expectations that created extraordinary expansion of zinc mining, and now the industry is almost paralyzed, while a number of properties are maintained in readiness for active operation merely in the hope of an early decision by the Government. Such methods are wasteful of men and money, and in the end leave us crippled when the output of the mines is urgently needed. The Department of Agriculture has been justly criticized for policies that place obstacles in the way of increased food production. On account of the extraordinary demand for sulphuric acid to make munitions a shortage of fertilizers exists, but no organized effort has been made to conserve the wasted materials that should be utilized in 'compost heaps', nor to encourage efforts to improve the soil without the use of super-phosphate, where that is insufficient. Government financial aid is urgently needed to develop additional sulphuric-acid plants in the West where advantage might be taken of the vast deposits of phosphate rock that now remain unworked. Furthermore, the plan to bring under cultivation the great area of 'cut-over' lands in the Middle-West and South, in order to obtain the benefit of virgin soils, at a time when fertilizers are scarce, actually has been discouraged by the Department. President Wilbur of Stanford University says that the American people have not wakened to the reality of the War, but the time has come when they must rouse themselves. They must realize that the committee that fails to organize industry, the official that retards the output of the necessaries of life, the man that temporizes or exalts his selfish interest above that of the common good, all these are giving aid to the enemy, and must no longer be suffered to stand in the way of effective prosecution of the business of preserving our republic. The country possesses an abundance of men able to take the places of any incompetents and force the work with energy. The spirit that should prevail was well expressed in the advice given by a committee of the Senate to Secretary Baker the other day when he was told to cut red tape and order the commanders at the military camps to buy clothing for the soldiers in the nearest market. By request of the President this advice has been converted into a slogan for all the Departments at Washington. The object must be to do the things that need to be done and to do them swiftly, if we are to win. Efficiency is excellent, but, after all, efficiency is mechanical perfection and involves routine that takes time to develop. There is something superior to efficiency, something for which free America has been conspicuous in the past, and in which she has not yet lost her cunning. That thing is competency, which is the ability to do things with power.



The Rusting of Iron

The Editor:

Sir—The article in the MINING AND SCIENTIFIC PRESS for December 8, 1917, on the above subject, contains the following statement regarding the Bureau of Mines: "The Bureau rejects the electrolytic theory that has been so universally accepted, on the ground that pure iron, that is to say, the purest iron obtainable, rusts and pits as badly, and often worse, than the impure product." What the Bureau says in its 1916 Year Book is that "many of the actual facts observed . . . are not satisfactorily accounted for by the usual interpretation of the electrolytic theory." There is, in reality, nothing in the electrolytic theory which does not square with "actual facts observed," and the only trouble is with the "usual interpretation" of the theory. Exponents of the electrolytic theory have never claimed that pure iron does not rust, but many manufacturers of pure iron have gone too far in claiming immunity to corrosion for their product on account of its high purity, forgetting that different polarity, causing electrolytic action, may also be caused by distortion or unevenly stressed parts in the metal and by accumulations of rust or dirt on its surface. These factors are, indeed, quite as important in promoting corrosion as impurities contained in the metal itself, and this is entirely in accord with the electrolytic theory, albeit not with the usual interpretation thereof. By pure iron is understood certain products of the open-hearth processes which are marketed today and which should more properly be called pure steel, for they lack both the graphite contained in cast-iron and the slag contained in genuine wrought-iron. Cast-iron and wrought-iron are very durable products, in spite of the large proportion of graphite and slag that are incorporated in the pure iron, but one should not be misled into construing this as a contradiction of the electrolytic theory, for it is apparent that both the graphite and the slag, being in themselves practically non-corrodible substances, must, on account of their fine distribution, protect the underlying iron from corrosion. This protection must increase as more and more of the slag and graphite respectively becomes exposed by corrosion, so that there will be a marked slowing of the corrosive effects after years of service. A mistake often made is to put commercial wrought-iron under the term 'pure iron'; while it is pure in a chemical sense, it is equally certain that it contains from 5 to 6% of slag mechanically mixed with the iron, and, in my opinion, it is this very slag that gives it the characteristics that distinguish it from pure steel, namely, a tough fibrous structure, tremendous resistance to vibration and repeated stresses, and a high factor of immunity to corrosion.

N. BOWLAND.

Pittsburgh, Pa., December 18, 1917.

Recruiting Labor From Gold Mines

The Editor:

Sir—S. E. Rau-Roesler's argument concerning the ethics of certain engineers and the reflections thereof on the profession in general, has aroused deep interest on my part, and has brought to mind ideas embracing the interrogative: Would it be consistent for a man, whether engineer, metallurgist, or miner, to refuse the acceptance of what he considered a better opportunity if such should present itself? In fact, do we not all encourage such a system by even so small a thing as a business card, and by our earnest endeavors to produce results? Our stock in trade is our brains and labor which we sell or lease to the highest bidder if said bidder is financially able to cover his bid, as we must figure on covering the initial plant, our brains, together with depreciation at an early date in life. Allow me to suggest in this connection a method of combating the Inspiration system of procuring labor. Would it not be much better to visit with the miners whom Mr. Arnold had employed, wish them good luck, a pleasant journey, and incidentally mention that your company stood ready to pay their return fare and that of any other good men they could secure while working for the Inspiration, at the same time sticking up some posters showing the miner's wage at each camp, the methods of working men, the living conditions, and general surroundings. With the balance in favor of the garden, I am sure such a procedure would bring results.

J. WARRINGTON STOCKHAM.

Eureka, Utah, November 26, 1917.

The Need for Gold

The Editor:

Sir—Under your issue of December 1, I notice an article on this subject by Lester S. Grant. I would like to make a few comments on same, though they are rather rusty, as I have not been in South America since 1910 and 1911, where I came in contact with a good many drummers from various parts of North America and

Europe, who were selling goods payable in Peruvian soles, which is a facsimile of the English pound sterling, the only Government in South America that has prohibited the issue of paper money.

In the larger cities of Chile, to wit, Valparaiso and Santiago, landlords some fifteen years previously rented their premises at approximately $300 per store, payable in Chilean money, which at that time, if my memory is correct, had depreciated to about 25c. on the dollar, the depreciation of which bankrupted a great many landlords; in both Chile and Argentine, where paper money is exclusively used (paper money in Chile being worth then about 25c. on the dollar and in Argentine about 50c. on the dollar) there being no gold in circulation, restaurants omitted from their bills of fare the price of ham and eggs and everything else, and the price paid was the quotation of paper money at its value for that day.

As Mr. Grant says, we may have a gold and silver stock sufficient for what we think is necessary for this year and possibly the next, but if gold is smuggled out of our country, as it has been in South American countries, with the exception of Peru, our paper money will have no more value than Confederate money, which was backed by no gold reserve at all. Without a plentiful supply of gold and silver our paper money is worth no more than yesterday's newspapers which kindle tomorrow's fires.

FRED S. ROWAN.

Independence, California, December 20, 1917.

Oil in Flotation

The Editor:

Sir—I have read with interest statements by yourself and by others that oil was not necessary for floating mineral particles, yet so far as I have read no one has stated what these reagents are or what results were obtained by their use. In a recent issue of your paper, Mr. Schwarz states that he is successfully floating lead from zinc, making nearly as complete a separation as that of any other mineral floated from its gangue, yet he neither states what reagents he uses nor the results. I am treating a high-grade lead-zinc ore, and the best results I have obtained are about 50% lead and 24% zinc by the use of eucalyptus oil. The feed is about 3% lead and 20% zinc; after selective flotation of lead and flotation of zinc, the tailing contains trace of lead and under 2% zinc. Will some of your writers kindly give figures of their results on the selective flotation of lead?

MILLMAN.

Los Angeles, December 29, 1917.

[We have referred editorially more than once to the use of nitro-naphthalene and alpha-naphthylamine, patented by H. P. Corliss, as a frothing-agent instead of oil. Naphthalene is the moth-ball of commerce. Both the above-mentioned reagents are derivatives from naphthalene, which, in turn, is the creosote fraction from the distillation of coal-tar, itself a by-product of the coke-oven. The naphthalene is nitrated with nitric acid, the resulting alpha nitro-naphthalene is then treated with hydrochloric acid and iron shaving, which reduces the nitro-compound to the amine derivative, producing the alpha naphthylamine, which is the frothing-agent—$C_{10}H_7 \cdot NH_2$—used in flotation. Its solubility is in the ratio of 1000 : 1 in cold water and 600 : 1 at 50° C. From ¼ to ½ pound per ton of ore suffices to produce a highly efficient froth. In regard to the selective flotation of lead, our correspondent is referred to the chapter on 'Differential Flotation' by O. C. Ralston in the book entitled 'Flotation', published recently.—EDITOR.]

Misfires

The Editor:

Sir—In reply to Mr. Harrington's article on misfires, in the December 1 issue of your paper, will say that if proper care is given to trimming the fuse-end that is used for the cap, a large percentage of misses will be avoided. I have been employed at the Tamarack mine, at this place, where there has been considerable trouble with misses; the miners say it is the caps, others say the fuse; I found it was a dull knife used and fuse cut square across; also carelessness in inserting the fuse into the cap. I have taken caps where the fuse had burned to the cap and cut new fuse properly and exploded the cap. I have noticed that the man who makes the primers generally tries to see how fast he can work, and cuts his fuse with a dull instrument square across, and nearly always there is a little gutta percha drawn across the powder; he then forces the cap on, and crimps; the result is a few misses. When I want to be sure of my round, I try to cut my fuse with a sharp knife diagonal with the fuse, make a clean cut, and when inserted in the cap I see that it does not jam but goes in free—do not crowd it hard against the powder, then crimp. For wet holes let him use P & B paint. You can crimp your cap on ever so well, but if you don't cut your fuse right and with care you must expect misses. Let your contributor try my scheme, and I am sure he will get results, as I have used this method where others fail. If he gets results from my method, then I will feel re-paid for this letter.

HENRY HOARD.

Sunset, Idaho, December 12, 1917.

[Our correspondent has hit upon a probable cause of the trouble mentioned by Mr. Harrington. We had previously made a similar suggestion in an editorial article entitled 'Blasting Troubles' in our issue of December 8. We called attention to the pinching of the fuse in cutting with a defective instrument of the type commonly supplied in which a fuse-cutter and crimper are combined in the same tool. The dull knife, as Mr. Hoard points out, would have a like effect. The dragging of the outer layer of gutta percha across the powder-core is a fertile cause of failure to explode the cap. In general we advise the square cut.—EDITOR.]



BOGOMOLOVSKY MINES: GENERAL VIEW AND WORKMEN'S HOUSES

The Bogomolovsky Copper Mines, Russia

By N. T. TRUSCHKOFF

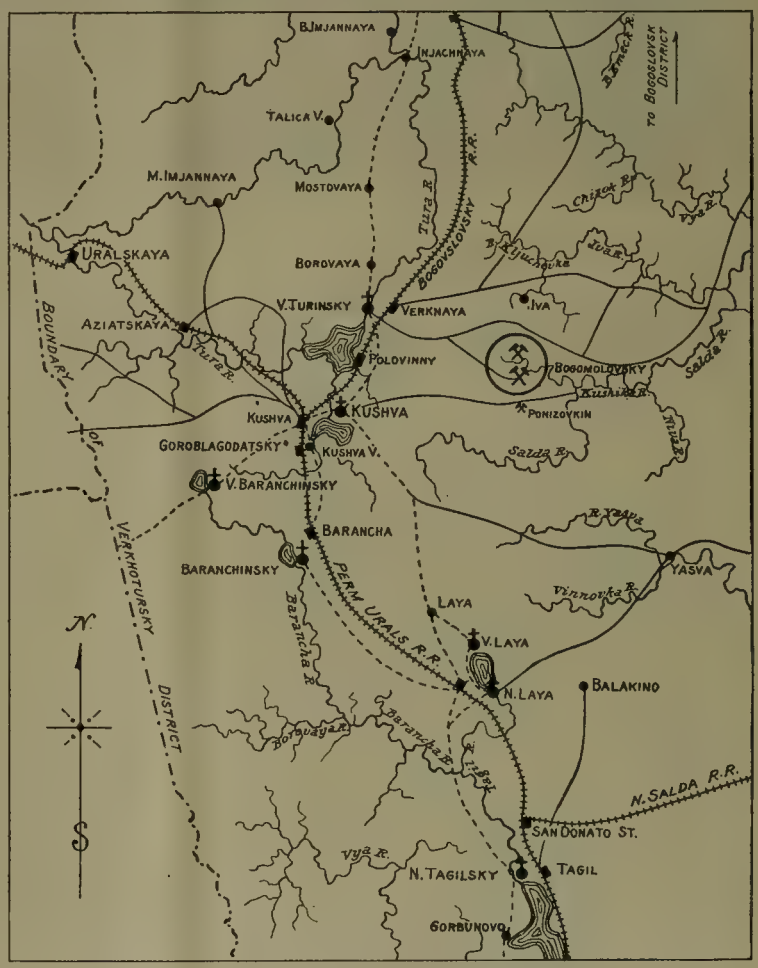
These mines are in a pyrite belt on the eastern slope of the Ural mountains, formerly worked for gold until copper pyrite was found below the gossan.

The Bogomolovsky mines belong to the Bogoslovsk Mining Co.; they are situated 10 miles north-east of the station Goroblagodatskaya on the Perm & Gornozavodsk railroad in the Verhotursk district, department of Perm; they also lie six and one-half miles south-east of the station Verknaya on the Bogoslovsk railroad, which runs to the Bogoslovsk company's Nadejdensky iron works and connects the Perm with Bogoslovsk railroads, the Nadejdensky works being the terminal of the Bogoslovsk narrow-gauge line. A standard-gauge line is under construction now to connect the Bogomolovsk mines with Verknaya; this branch railroad was expected to be ready by the end of the current year. Eight and one-half miles south-west of the mines is the Government's Kushva iron works with its famous Mount Blagodat iron ore deposit; 10 miles south of the Kushva begins the Nijny Tagil—one of the largest and oldest mining districts in the Ural region, producing iron, copper, platinum, and gold. The accompanying map shows the relative position of the mines to the neighboring country. All the surface near the Bogomolovsky mines is covered by forest; the district is intersected by many small rivers, whose gravels have been worked by local diggers ('starateli') for gold and platinum. Bogomolovsky, however, promises to become far more important for its copper. Four small rivers are on the strike of the ore-bearing zone; going north they are Salda, its tributary Kushika, and Tva, with its tributary Kljuchovka, the Salda having enough water for a metallurgical plant. Two groups of mines were bought by the Bogoslovsk Mining Co. from Mr. Bogomoloff's successors: a western group, consisting of two claims, Plastorazdelny and Verinsky, marked on the map, and an eastern group, adjoining the first one and including 21 claims, which represented the main gold-bearing area at the time of Mr. Bogomoloff's operations. Only the western group is being developed now, the prospecting work on the eastern group being barely started.

The copper-bearing zone trends north-south and includes the western group of two claims, to which adjoin four new Bogoslovsky claims. South of the Plastorazdelny claim are the Ponizovkin gold mines with a pyrite deposit, and two similar deposits belonging to Ushkoff & Co., producing pyrite for large sulphuric-acid plants and dye works on the Kama and Volga rivers, of eastern and middle Russia. North of the Verinsky claim are the so-called old and new Levinsky mines near the Kljuchovka river, on the Verkne Turinsk peasant lands, 3000 dessjatins (each 117,600 sq. ft.) of which are leased by the company under a special agreement. Farther north on Government land, up to the Emech river, intensive prospecting is in progress on all the ground controlled by the company; altogether an area more than 15 miles long by 1 mile wide belongs to the Bogoslovsk Mining Co. along the general strike of the ore-bearing zone. A subsidiary company is to be formed to operate this property. The country-rock is granite and 'keratophyre'; the granite is not productive where massive; the keratophyre represents, according to the Bogoslovsk Geological Survey, an effusive soda-felsite porphyry, the main constituents of which are albite and oligoclase, seldom hornblende. The rocks forming the larger part of the mineralized area are altered keratophyre and its derivatives, metamorphic schists, more or less chloritic, which vary in color, being dark-gray, red, yellow, and white.

This belt of metamorphosed mineral-bearing schist extends N. 15° W. and is about three-quarters of a mile wide. Copper-bearing pyrite occurs in the form of lenses in the highly altered argillaceous schist, which near the contact is nearly white. A gossan cap, about 60 ft. thick, is always found on the top of the ore; the outcrop is under the soil and debris, 3 to 10 ft. thick, the country being swampy and thickly covered by forest and brush. The schist belt is intersected by several porphyry dikes, which have, as far as we know now, no influence on the mineralization. The mineralized belt is on the line of other deposits of cepper-pyrite on the eastern slope of the Urals, being the continuation of those at Kyshtim, Syssert, and Kalata. Pyrite was lately found on the same strike on the Vinnovka river in the adjacent Nijne-Tagilsk district.

Four diamond-drills are working continuously along the belt at places where gossan has been uncovered by prospecting pits. The first lens of cupriferous pyrite was found in 1915, on the boundary of the Verinsky and Bogoslovsky No. 3 claims by a pit that struck the gossan several feet below the surface. Ten diamond-drill holes were set along the strike of the cap as ascertained by pits and cut the vein at vertical depths ranging from 95 to 735 ft. All the holes incline 45° south-west (three are 52° and one 60° south-west). In the hanging wall the incline depth of the holes is from 328 to 1297 ft., the distance between the holes averaging 164 ft. The average width of the lens down to the level, at 686 ft., is 50 ft. The lens strikes N. 24° W. and dips N. 70° E. The ore-reserve of 3,400,000 short tons, to a depth of 660 ft., will average 3.6% copper. The ore persists in depth, so far as known. Several more drill-holes have been started to cut the lens at a greater depth. The average assay of ore from the drill-holes shows 40% S, 10% SiO_2, 40% Fe, 1% CaO, 0.75% Cu (from traces to 12%). The depth of oxidation is 60 ft. A second lens has been uncovered on the Novo-Levinsky claim, along the same strike; two drill-holes cut pyrite containing copper; drilling is progressing and according to data available this lens is similar to the first one both in size and value. The ore-bearing belt of schist is being systematically prospected along the strike by pits 4½ by 3 ft., inside timbers; the lines (across the strike) of the pits are 700 ft. apart, the distance between pits on each line being 70 ft. Pits are sunk until they strike original rock or gossan; if the latter, the pit is sunk deeper and a cross-cut made. Stripping overburden is started at the outcrop of the second lens where the gossan is shallow. Development work was started in 1916. One vertical three-compartment shaft, the No. 7 Bogoslovsky, 14 by 7 ft. inside timber, was sunk in the hanging wall of the first lens and has cut the vein in a cross-cut at 105 ft., where a station is established and drifts started north and south. The sinking of this shaft is to be continued. Several other shafts, 9 ft. 4 in. by 4 ft. 8 in. inside timber, have been sunk to the same depth as the main shaft along the line of gossan at the distance of 150 to 200 ft. for ventilation and for lowering timber. Two assays of the gossan, cut when sinking the shaft, 28 and 35 ft. from the surface, respectively, gave 17.82 to 33.83% iron, 0.05 to 0.10% sulphur, $3.90 to $10.28 gold per short ton. The gossan may be suitable for cyanidation. Assays of ore on the 105-ft. level (40 ft. below the gossan) gave from 33.50 to 43.88% sulphur, 9.24 to 26.89% silica, 27.12 to 38.02% iron, traces to 0.43% zinc, 4.6 to 12.65% copper. A sample of 976 short tons of bulk ore taken between the 70-ft. and 105-ft. levels was smelted at the Bogoslovsky copper smelter last summer and yielded 7½% copper.



MAP OF PART OF URAL REGION







Owing to the present political conditions only prospecting work and small development work are possible now. Ingersoll-Rand hammer-drills are mostly used in driving and sinking. The driving is done by contract at a price of 130 rubles per cubic sagene ($65 per 343 cu. ft., or about $9.30 per linear foot of 7 by 7 ft. drift) timbering and explosives included; stoping costs R75 per cubic sagene (a sagene is 7 ft.). An Eclair (Belgian make) 40-hp. belt-driven compressor delivering 300 cu. ft. free air per minute is working now, and an Ingersoll-Rand Imperial type XB2 compressor, of 1051 cu. ft. per minute capacity, has been ordered.

A village for the employees and workmen was under construction during the summer. Three-shift work of eight hours is carried on underground. The average earnings for Russian miners in the month of May last were: Drillers R3.77 ($1.89 at pre-war exchange) per 8-hour shift, timbermen R4.64, trammers 4.50, day-laborers underground 3.14, surface 2.35, smiths 5.43, helpers 4.50, fitters 3.50 to 5.85. Besides Russians, who number only 50, Chinese and war-prisoners, up to 150, are employed, mostly on surface. War-prisoners underground receive R2 to 2.50 per shift on contract and R2 on day's pay. The average Chinese wages are R2 daily.

A modern reduction-plant is to be erected near the mines, with a sulphuric-acid plant. The ore now produced is transported to the Bogoslovsk works, where it is smelted in two water-jacketed blast-furnaces, 228 by 42 in., and 84 by 36 in. at the tuyeres, together with local ore from the Toorinsky copper mines.

Ventilation pit No. 203 and shaft No. 7 are poor in sulphur (7 to 12% S). The Bogoslovsk smelter has extra capacity for treating 60,000 tons of pyritic ore per annum, besides local ore. The addition of Bogomolovsk pyrite to the charge, owing to its sulphur, reduces the percentage of coke required and results in a considerable decrease of cost.

Conditions in Russia at the present are unfavorable for starting any large mining enterprise; but after the end of the War there will be great possibilities for an extensive development of the mineral regions. The present tangled situation will not last long. The defeat of the Bolsheviki, who emporarily control Petrograd and a few other industrial centres where the workmen are swayed by radical socialistic sentiments, is certain. The Bolsheviki represent Russia no more than the I. W. W. represent the United States. The heart of Russia is sound, and the mass of the people is against Germany. The Germans may make peace with Lenine, Trotzky, and other traitors and German agents from the Smolny Institute, but they can never make peace with real Russia. The extreme socialistic parties have no following among the bulk of the population. The more moderate parties and all the reasonable soldiers not spoiled by German propaganda are consolidating with the middle classes. The election for a constitutional assembly will help in the establishment of order. The accompanying photographs show the No. 1 shaft as it appears at the present time.

An M. S. Contract

The following contract was offered to the inventor of an improvement in flotation. We comment upon it on the editorial page.

AGREEMENT made and entered into this — day of June, 1917, by and between John Doe, party of the first part, and Minerals Separation North American Corporation, a corporation organized under the laws of the State of Maryland (hereinafter referred to as 'Minerals Separation'), party of the second part. Witnesseth:

WHEREAS Minerals Separation is the owner of or is interested in or controls certain patents for processes and apparatus for the separation or concentration of ores; and

WHEREAS Minerals Separation is engaged in the business of granting and has granted licenses for the use of said processes and apparatus to the owners of mines, mills, or dumps in which license agreement it is provided, among other things, that the said owners to whom licenses to use the said processes and apparatus have been granted shall not use any apparatus in the operation of said process manufactured by any one other than Minerals Separation without the consent of Minerals Separation in writing; and

WHEREAS the said Doe has invented an apparatus which is capable of being used for carrying out one or more of the processes owned or controlled by Minerals Separation; and

WHEREAS Minerals Separation is willing to consent that the aforesaid mine, mill, or dump owners, who are licensed under its various patents, may use the apparatus invented by the said Doe; and

WHEREAS it will be impossible to estimate the damage and injury done to Minerals Separation if the said Doe furnishes to the owners of mines, mills, and dumps, who desire to infringe the patents owned and controlled by Minerals Separation, apparatus capable of carrying out the process or processes owned or controlled by Minerals Separation; and

WHEREAS in consideration of the aforesaid consent of Minerals Separation the said Doe is willing to undertake that none of the machines hereafter sold by him will be employed by purchasers or users in the infringement of patents owned or controlled by Minerals Separation:

NOW, THEREFORE, in consideration of the sum of One Dollar each to the other paid, the receipt whereof is hereby acknowledged and in consideration of the mutual covenants hereinafter contained, the said Doe and Minerals Separation hereby mutually agree as follows:

1. Minerals Separation hereby agrees that it will consent that the owners of mines, mills, and dumps, who have been licensed to use the patented processes or apparatus owned or controlled by Minerals Separation, may use apparatus invented by Doe in the carrying on of any of said processes for the concentration of ore.

2. The said Doe agrees to pay to Minerals Separation, for such consent, ten (10%) per cent of the gross selling price of each and every machine sold to licensees of Minerals Separation, payment of said commission to be made to Minerals Separation free of exchange in New York within ten (10) days after the delivery of or payment for each machine. In the event that any machines are sold to the owners of mines, mills, and dumps who are not licensees of Minerals Separation but who subsequently become licensees, the said Doe agrees to pay to Minerals Separation ten (10%) per cent of the gross selling price of each and every machine so sold as soon as Minerals Separation gives its consent to the purchaser to use the same.

3. The said Doe agrees that he will not sell any apparatus capable of carrying on the processes owned or controlled by Minerals Separation to anyone for the purpose of infringing patents belonging to Minerals Separation, and the said Doe hereby guarantees that none of the machines hereafter sold by him will be used to infringe the patents belonging to Minerals Separation.

4. In the event that any of the machines hereafter sold by the said Doe shall be used by the purchasers or users thereof to infringe any of the patents owned or controlled by Minerals Separation, then in that event the said Doe agrees to pay to Minerals Separation ten thousand ($10,000) dollars as liquidated damages for each machine employed in infringing the patents owned or controlled by Minerals Separation.

5. This agreement shall be binding and inure to the benefit of the successors in interest of the said Doe and of Minerals Separation.

IN WITNESS WHEREOF the parties have hereto set their hands and seals the day and year first above written.

Wolframite in South China

A recent discovery of wolframite in marketable quantities has been made in Kwangtung province. Following the discovery the natives, and even the official deputies, mistook it for manganese or iron ore, until the high prices offered raised a suspicion that it must contain something different from the common metals. The Japanese first learned of the value of the so-called 'iron ore' in Hunan province, and offered about 27c. Mexican, or 17c. gold, per pound for it. Other buyers learned of the bargain, and offered better prices. Now the average ore commands about $32 gold per 100 lb. at Canton. Much of the ore comes from Chengchow, adjacent to the border of Kwangtung province. It is transported on men's backs to Ping Shek, a distance of 60 miles. From here it is carried in junks down the North river to Shiuchow, 80 miles, whence it is brought to Canton over the Yueh-Han railway. Haifong district has been reported to produce wolfram ore, but no actual mining has begun. Kwangsi province also is said to produce it. A Chinese company, while prospecting for antimony some time ago in Kwangsi, found small seams of wolfram in the Hochi district, 120 miles north-west of Liuchowfu. The ore occurs in hard quartz, and the cost of mining is excessive.

Buying Combinations in the Metal Market

BY THE FEDERAL TRADE COMMISSION

Close Inter-relation of Producers, Traders, and Larger Consumers

*Before the War the control of the world's metal market was in the hands of a group of German metal-traders, who are primarily engaged in buying metal, or in acting as selling agents for producers, and in selling it to European and Asiatic consumers. From the standpoint of the American metal-producers they are to be regarded primarily in the light of buyers, although in a broader sense they might well be defined as traders, since they both buy and sell. The description of their activities here given is from the American point of view. In a general way, it may be said that in Germany is centred the control over many of the largest producers of metals, while the London Metal Exchange and silver 'fixing board' exercise and control the price-fixing power to such a degree that London has become the international market for almost all metals, and that London metal quotations set the standard for the metal business the world over.

With regard to the fixing of prices in the metal market the national and international metal cartels and syndicates are of primary importance. The metal trade is notable for the extraordinary degree in which it has been concentrated in the leading metal-producing and metal-consuming countries of the world. A comparatively small number of firms control this trade the world over, and most of them are more or less closely interrelated. These combines fix the price and regulate the production of the metals and metal products controlled by them in their respective territories, and thus indirectly have an important bearing on the price question as it affects the metal market. The part played by the banks in the control of the metal business is largely responsible for the internationalization of the metal trade. Through syndicate agreements, price cartels, and interlocking directorates, certain banks of England, Germany, Holland, Switzerland, and Belgium have managed to secure control over the largest metal plants and metal-selling agencies of the world.

Another interesting feature of the metal combines consists in the fact that a number of large and important industries are dependent upon the metal trade for their supply of raw materials. Among these the electrical and the chemical industries rank foremost. Almost half of the total copper production is used for electrical purposes.

This close inter-dependence as well as manifold other common interests have been instrumental in bringing about a far-reaching system of co-operation among the leading metal firms and industrial cartels and syndicates. Thus the Metallgesellschaft of Frankfurt before the War was the common selling agency for the French Aluminum Syndicate, and it serves in a similar capacity, together with Beer, Sondheimer & Co. of Frankfurt, and Aron Hirsch und Sohn, of Halberstadt, for the German Zinc Syndicate. Aron Hirsh und Sohn are members of the German Copper Sheet Syndicate and of the Combine of German Copper Wire Works. The Deutsche Gold- und Silberscheideanstalt is closely allied with the chemical industry and is a member of several chemical cartels. In 1900 it organized and managed a syndicate of calcium-carbide manufacturers. In the latter industry the Siemens-Schuckert concern, one of the groups that control the German electrical business, is heavily interested. By means of the Metallurgische Gesellschaft the Merton interests, which are the chief factor in the metal-buying combination, acquired large holdings in the German potash industry through the Gewerkschaft Rastenberg. On the chart opposite page 366 [on page 87 of this issue] the number and extent of these inter-relations is presented.

Through banks, holding companies, affiliations with syndicates and cartels, interlocking directorates, joint-share holdings, and other means of inter-relation, a world-wide ramification has taken place in the metal trade.

The following examples will illustrate how some of the more important metal concerns are allied through interlocking directorates. Of the Merton family, of Frankfurt and London, five members are directors in most of the companies controlled by or affiliated with the Metallbank of Frankfurt; R. Merton is connected with the Merton Metallurgical Co., London, the American Metal Co., Ltd., the Australian Metal Co., Ltd., and the Compagnie des Minérais de Liège. Walter Merton is a director of the Metallbank & Metallurgische Gesellschaft, Frankfurt a. M.; the Metallgesellschaft, Frankfurt a. M., and of the Merton Metallurgical Co., London. H. Gardner is on the board of directors of Henry R. Merton & Co., the Australian Metal Co., the Merton Metallurgical Co., the Mines de Pierrefitte, and Williams, Foster & Co. A. Ladenburg is a director of the Metallbank and of the Schweizerische Gesellschaft für Metallwerke. Walter vom Rath is a director of the Metallbank, the Metallgesellschaft, the Lahmeyer electrical concern, the Höchster Dye Works, and the Allgemeine Electrizitäts Gesellschaft.

*Taken verbatim from 'Report on Co-operation in American Export Trade'; Federal Trade Commission; June 30, 1916.

The Frankfurt metal firms are also connected with some of the leading German banks through interlocking directorates, viz., the Hirsch concern with the Deutsche bank; the Deutsche Gold- und Silberscheideanstalt with the Metallbank, Frankfurt a. M., and the Oberschleisische Zinkhütten A. G., Kattowitz, with the Nationalbank für Deutschland.

Silver. According to the statement of a large American concern, which exports about seven-tenths of its silver output to London, the silver trade of the world is dominated by the London Metal Exchange:

The price of silver is fixed in London by what is termed publicly the 'fixing board,' which consists of four banking or brokerage houses dealing in silver and Eastern exchange. This board of four representatives meets at a quarter past two every afternoon. This permits prices to be made in New York at the opening of business here, on account of the difference in time. Since virtually the entire silver business of London is in connection with exportations from the United States, it will be seen that the meeting-time in London is after the members of the fixing board know the full receipts and demands in London, but before business opens in New York. All silver in London is sold through these members of the fixing board. The distribution of silver in London, as stated above, is approximately 75% for shipment to the East, which is sold entirely to Eastern banking representatives, both English and continental, for coinage purposes, and, to a minor extent, to the manufacturers of silver. The Eastern banks and the Government representatives will not buy through anyone except members of the fixing board, and at the fixed prices, because if they do otherwise they take a responsibility which they do not seem to be willing to take. In fact, if they should buy in any quantity from other parties, the fixing board would probably fix a price that would make their purchase open to criticism. These four brokers, therefore, have the ability, and exercise it, to absolutely fix every day the price at which the entire product of the mines of the United States in silver has to be sold.

This fixing board has, however, a much greater power than that covered by the actual transactions in fine silver, for the reason that the commerce of the East, India, and the Straits Settlements and China is expressed in silver; in other words, the entire exchange transactions of London, covering the entire commerce between the continent of Europe and India, is expressed in silver values, and the price of silver is the price of exchange. These exchange transactions are at least ten times as great as the total value of silver purchased and sold in London. The great Eastern banks are the great buyers not only of silver for export to the East, but also of the exchange covering the commerce with the East. The silver value of the American mines is dominated by four brokers, designated as a fixing board.

Copper. According to the statement of a large American concern, which exports about six-tenths of its copper output to Europe, prices established by the London Metal Exchange determined to a large extent prices of copper at any port in Europe. Since the present War the British director of materials promulgated the following regulations in relation to sales of copper:

1. Orders up to and not exceeding 50 tons may be placed in the usual way, without reference to the Minister of Munitions.

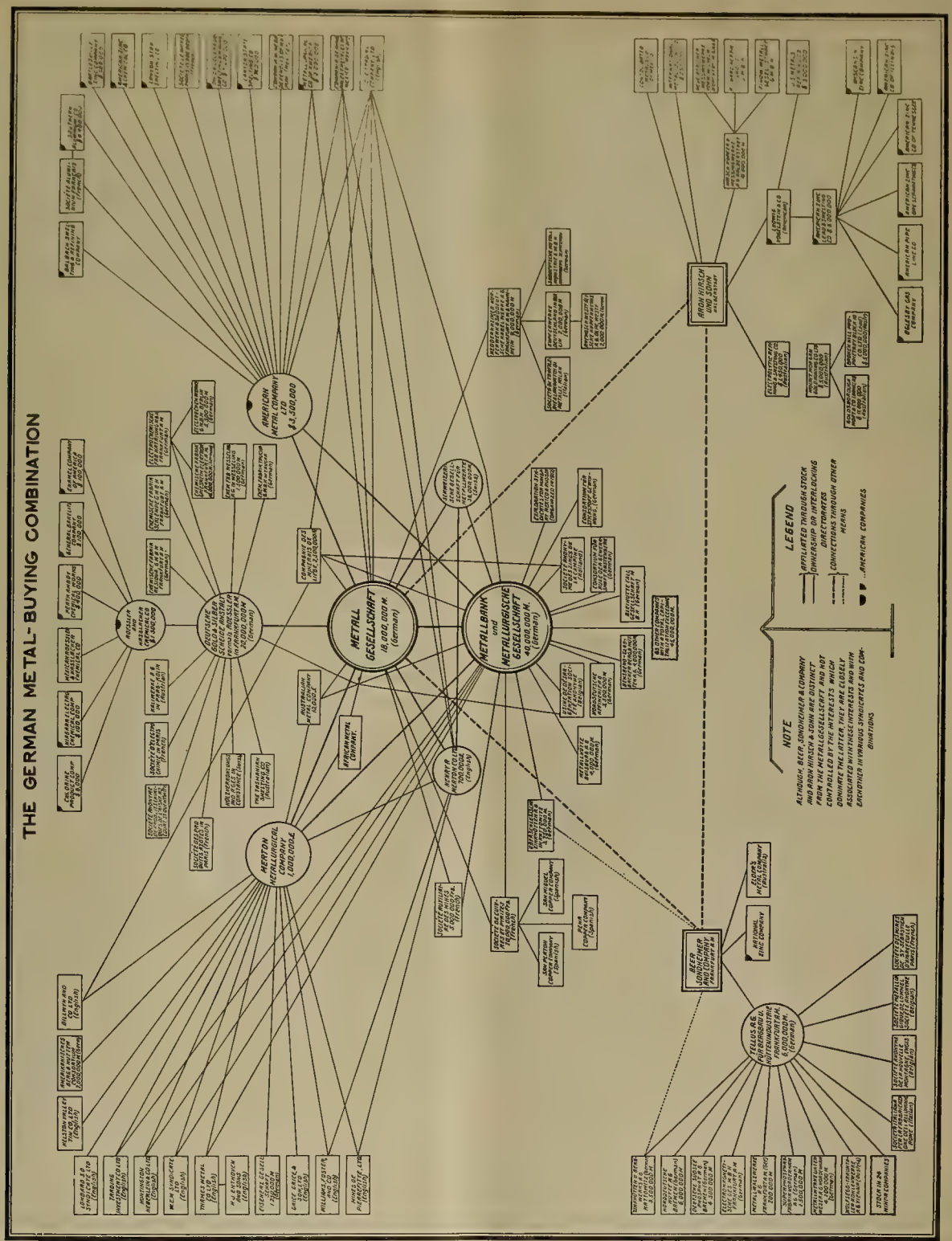
2. No orders for best selected or electrolytic brands of copper shall be placed at prices exceeding £100 per ton, without first consulting the director of materials.

Commenting on the effects of this order, the American concern said:

This action was taken on January 5 last. The immediate effect of this action with reference to copper was to stop the buying. The British Government, stating that they were acting also for their allies, Russia, France, and Italy, had previously negotiated large purchases of copper in this country for delivery spread out over a year. A very large proportion of the amount of copper exported is now being purchased by Governments, all acting in conjunction with one another, and is being distributed by these Governments to their manufacturers. Furthermore, we know that our sales of copper, made to the largest consumer of copper in France, are being distributed by them to their normal competitors at the present time.

On the subject of the purchase of copper by German buyers before the War, the American concern stated: The German consumption was such a large proportion of the total amount of copper exported that German buyers had more influence in fixing the value of copper than the English buyers. It was very evident to this company that the buyers of Germany at least worked as a unit. They would repeatedly remain out of the market for weeks at a time and would not accept any offer made, during which time the American sellers would accumulate such amounts of copper that they would be obliged to reduce their offers. The German buyer would wait until the offers were reduced sufficiently and then would come in again as the unit and buy in very large quantities. This process of buying at the lower and refusing to buy at the higher price, which was naturally stimulated by their very heavy buying at the low price, resulted in the average price at which the American buyer, who bought more regularly and was more inclined to buy at the panic high prices, could buy. The result is, so far as the sales of this company are concerned, and we believe that there is a similar condition on the part of other sellers of copper for exportation, the average export price is considerably lower than the average price obtained from the American consumers. The difference arises entirely from the selection as to the time of buying and not from the holding of a price at any one time by this company to American consumers above that offered to consumers abroad.

On conditions in the German market since the War began, the American concern said: In Germany at the beginning of the War a combination of all the large German consumers and metal merchants was made, known as the Kriegsmetall Gesellschaft. This combina-


THE GERMAN METAL-BUYING COMBINATION
METALL GESELLSCHAFT
18,000,000 M.
(German)
METALLBANK
METALLURGISCHE
GESELLSCHAFT
40,000,000 M.
(German)
AMERICAN METAL COMPANY LTD
$3,000,000
DEUTSCHE GOLD- UND SILBER-SCHEIDE ANSTALT
formerly ROESSLER & HASSLACHER CHEMICAL CO.
20,000,000 M.
(German)
ROESSLER & HASSLACHER CHEMICAL CO.
$1,500,000
MERTON METALLURGICAL COMPANY (LIMITED)
£1,000,000
ASTER & CO.
(German)
BEER SONDHEIMER & CO.
FRANKFURT a/M
IRON HIRSCH & CO.
NEW YORK
TELLUS A.G. FÜR BERGBAU UND HÜTTENINDUSTRIE
£2,000,000 M.
(German)
LEGEND
AFFILIATED THROUGH STOCK OWNERSHIP OR INTERLOCKING DIRECTORATES
CONNECTIONS THROUGH OTHER MEANS
...AMERICAN COMPANIES
NOTE
ALTHOUGH BEER, SONDHEIMER & COMPANY AND IRON HIRSCH & COMPANY ARE DISTINCT FROM THE METALL GESELLSCHAFT AND NOT CONTROLLED BY THE METALL GESELLSCHAFT, AND DOMINATE THE LATTER, THEY ARE CLOSELY ASSOCIATED WITH THESE INTERESTS AND WITH EACH OTHER IN VARIOUS SYNDICATES AND COMBINATIONS

tion has assembled and distributed the copper supply of the country. This is recognized as an incident of the War, but we are now informed it is proposed to continue this combination after the War is over. It would thoroughly and effectively combine all of the large tonnage of copper which has heretofore been purchased in this country, and place the American producers at a tremendous disadvantage. In Germany there are interlocking directorates, with large financial interests holding shares in the companies that are largest consumers of copper, which enables the management of the respective companies to act jointly in purchasing their requirements of copper in this country. The United States has heretofore supplied most of the copper used in Germany, and Germany has been the largest consumer in Europe.

The bearing of the conditions existing in the European markets on the copper industry in the United States may be understood when it is realized that the United States produces about 56% of the world's supply of copper, and exports about three-quarters of its annual production. In the year ending June 30, 1914, it exported 975,000,000 lb., valued at $145,000,000, seven-eighths of the exports being in the form of pigs, ingots, and bars. Of the total quantity of exports, 96% went to Europe. Germany took one-third of the exports to Europe. In addition to the quantity purchased by the great German metal-buying combinations, headed by the Metallgesellschaft, many of the large consumers of copper acted in concert in their purchases, through their cartel arrangements. According to one large American copper-producing company, they had reports from their Berlin agent of the existence of more than 50 combinations of copper-consuming companies for the regulation of prices, distribution of territory, and for concerted action in buying. According to John D. Ryan, of the Amalgamated Copper Co., European buyers, from 1903 to 1913, because of a buying combination, paid 83/100 of a cent per pound less for copper delivered abroad than domestic buyers for copper delivered at New York.

Zinc. The German zinc syndicate (Zinkhüttenverband) was organized in February 1909 with a capitalization of 2,000,000 marks for the apportionment of the output and for the fixing of the sales prices of zinc. The active organizers of the syndicate were the Metallbank of Frankfurt, controlled by the Merton interests; the Frankfurt metal-selling and holding company, Beer, Sondheimer & Co., which, through the Tellus joint-stock company, controls over a dozen metal and chemical concerns; and the firm of Aron Hirsch und Sohn, at Halberstadt. Both the latter metal-dealers established their own new zinc works at the moment of the organization of the German zinc syndicate.

Seven zinc works of Silesia and six zinc concerns of the Rhenish-Westphalian region at once joined the syndicate. The Metallbank, Beer, Sondheimer & Co., and Aron Hirsch und Sohn were made the exclusive selling agencies of the syndicate and the agreement was to continue for three years. Only one important concern, the Georg von Giesches Erben, retained its right to deal directly with the consumers, under the condition, however, that it should comply with the price-lists of the syndicate.

Immediately upon the organization of the German zinc syndicate (Zinkhüttenverband) an agreement was made with the Austrian and Belgian producers, of which the Vieille Montagne had works in Belgium, France, Algeria, Germany, Italy, England, Sweden, and Spain, and agencies in Tunis, America (United States), Japan, and Turkey. A Dutch concern (Zincs de la Campine) also joined the syndicate. The syndicate embraced altogether 18 firms. Ten Belgian and some French works formed another syndicate; so did six English works. During the same year, 1909, the competition of the United States concerns drove all these three groups together into the International Zinc Syndicate (Internationaler Zinkhüttenverband).

The International Zinc Syndicate was continued on November 10, 1910, up to April 1914. The syndicate agreement left the English and the French works free to fix their prices, and it is said that in some cases they underbid the German works. The agreement also provided that in case the reserve had reached 50,000 tons and the zinc prices in London had gone below £23 per ton the output should be reduced. Before the outbreak of the present War a 20% reduction of output was ordered.

The price changes made by the German Zinkhüttenverband always correspond to those made by the International Zinc Syndicate for the London Metal Exchange, which, it is said, gets its instructions from the Metallbank of Frankfurt, that is, from the combined Merton, Beer, Sondheimer & Co., and Aron Hirsch und Sohn interests. The zinc and other metal dealers of Germany act in unison as purchasers from any foreign concern.

By the end of 1912 the German Zinkhüttenverband controlled one-half of the world's output of zinc, and three-fourths of the European output. The International Zinc Syndicate regulates output only, while the German syndicate (Zinkhüttenverband) regulates both output and prices within its sphere. The actual price regulation is carried out by the Kölner Zinkhüttenverband, which appears to be but a subdivision of the German syndicate (Zinkhüttenverband). It must be remembered that the German syndicate has two distributing agencies—one in Cologne and the other in Kattowitz (Silesia). The published price quotations, however, do not represent strict sales prices, but form only the basic price on which the actual sales prices are computed.

Lead. In 1908 an agreement was reached between German lead works and Australian lead-mine owners as regards prices and apportionment of markets. The competition of Spain and of the United States compelled the lead interests to organize in the spring of 1909 the International Lead Convention. The Australian Broken Hill mines, the American Smelting & Refining Co., some Spanish and some Mexican mines, the Usines des Désargentation of Antwerp, and the German Bleihütte 'Call' formed a common sales agency under the leadership of

the Metallgesellschaft in Frankfurt, in Germany, and of the Henry R. Merton & Co., in London. This convention was continued in June 1910 for several years.

Aluminum. Close relations exist between the Merton concern and the aluminum industry, especially the French Aluminum Syndicate, and through the latter with the International Aluminum Cartel formed in 1912. The Metallgesellschaft of Frankfurt was instrumental in organizing the French Aluminum Syndicate in November 1910, and since then it has served in the capacity of its common selling agency, which handles the entire export of the French Aluminum Syndicate. The following companies are members of the French syndicate: Société Electro-Métallurgique Française ('Froges'), Compagnie des Produits Chimiques d'Alais et de la Camargue ('Salindres'), Société des Forces Motrices et Usines de l'Arve, Société des Produits Electro-Chimiques et Metallurgiques des Pyrénées, Société Electro-Métallurgique du Sud-Est, and the Société d'Electrochimie.

Several aluminum factories also manufacture calcium carbide, and in 1900 the Deutsche Gold- und Silberscheideanstalt organized and managed a syndicate of calcium-carbide producers, which was dissolved in the following year. An international carbide syndicate was formed in 1910 for a period of 10 years, of which all of the 58 carbide factories of Europe (in France, Switzerland, Germany, England, Austria, Norway, and Sweden) became members.

The electrical industry has for many years been closely connected with the manufacture of calcium carbide, especially the Schuckert interests.

In October 1910 the following German producers organized the German Aluminum Purchasing Association (Deutsche Aluminum Einkaufsvereinigung):

Fried. Krupp-Grusonwerk, A. G.
Julius & August Erbslöh.
Karl Berg in Eveking.
Vereinigte Deutsche Nickelwerke in Schwerte.
Th. Goldschmidt in Essen.
Basse & Selve, Lüdenscheid.

Through this purchasing combine the metal industry was connected with the Krupp concern, the great steel, ship-building, ordnance, and munition manufacturers, on the one hand, and with the copper and brass industry on the other. Basse is one of the directors of the Lüdenscheider Metallwerke, A. G., Vormals Jul. Fischer und Basse, a large consumer of metals, and a producer of fine machinery and various articles from copper, brass, and new silver. American metal exporters state that the Lüdenscheider Metallwerke, A. G., are also closely connected with the Metallbank of Frankfurt.

The German Metal-Buying Combination

There are three main groups of interests which together dominate the German metal market. They are the group identified with the Merton family, including the Metall Gesellschaft, the Metallbank und Metallurgische Gesellschaft, and the Deutsche Gold- und Silberscheideanstalt, the group identified with Beer, Sondheimer & Co., and the group identified with Aron Hirsch und Sohn. The principal relationships of these three groups are shown on the chart.

The Metallgesellschaft, Metallbank und Metallurgische Gesellschaft, and H. R. Merton & Co., Ltd. The Metallgesellschaft, A. G., Frankfurt a. M., was founded in 1881 by Wilhelm Merton. It took over the metal business of his grandfather Philipp Abraham Cohen. Wilhelm Merton was the son of the senior member of the firm of Henry R. Merton & Co. of London. When H. R. Merton started in business, P. A. Cohen supplied part of the capital, conversely, later on, H. R. Merton and his brothers Zachary and Emile, who had later become associated with him, also had a proprietary interest in the Cohen concern. When the two concerns were formed into limited companies these interests were capitalized in the form of shares in H. R. Merton & Co., Ltd., and in the Metallgesellschaft, A. G., Frankfurt a. M. In 1878 the London and the Frankfurt interests had already joined in the foundation of the American Metal Co. As a result of the predominance of the influence of the Merton family in these three companies, they have been generally known as the 'Merton concern.'

For the purpose of attracting outside capital, and in order to distribute the risk entailed by large investments, participating and financing companies were formed. The first step in this direction was that the Frankfurt, London, and New York firms turned over to separate holding companies their interests in mines and smelting plants which they had acquired in the course of time. In this way, in 1897, there was formed, as a subsidiary company associated with the Metallgesellschaft, the Metallurgische Gesellschaft, Frankfurt a. M. (capital 6,000,000 marks); in 1907, as a subsidiary company associated with the American Metal Co., the Metallurgical Co. of America (capital $2,000,000).

As the sphere of business interests of the Merton concern expanded into other countries outside of Germany, England, and the United States, the following additional holding companies were organized: The Compagnie des Minerais, Liège (capital 2,500,000 francs); the Société auxiliaire des Mines, Paris (capital 5,000,000 francs); and the Compañia de Minerales y Metales, Mexico. Together with the French banks, Cahen d'Anvers, the Société générale pour favoriser le dévéloppement du Commerce et de l'industrie en France, and other capitalistic groups, the Société des Cuivres et Pyrites, Paris (capital 30,000,000 francs), was organized in 1907 for promoting the development of three Spanish copper companies, the San Platon, the San Miguel, and the Pena Copper Company.

Two subsidiary companies of the Metallgesellschaft and of Henry R. Merton & Co. are the African Metal Co. and the Australian Metal Co. of London and Melbourne, respectively. They attend to the purchase and sale of metals in their respective parts of the world in behalf of the two parent concerns.

In 1906 the Berg- und Metallbank A. G., located at Frankfurt, was organized with a capital of 40,000,000 marks. This holding company was founded by the

Metallgesellschaft, together with the Metallurgische Gesellschaft, the Deutsche Gold- und Silberscheideanstalt, the Darmstadter Bank, the Berliner Handelsgesellschaft, the Diskontogesellschaft, and several private bankers of Frankfurt. From one-quarter to one-third of the capital in the principal undertaking of the Merton concern was turned over to the Berg- und Metallbank. In 1910 the Berg- und Metallbank A. G. was consolidated with the Metallurgische Gesellschaft into the Metallbank und Metallurgische Gesellschaft A. G., Frankfurt a. M., with a capital of 40,000,000 marks.

A chart showing the principal inter-relationships of the various companies in the group which centre in the Metallgesellschaft and the Metallbank und Metallurgische Gesellschaft has been prepared by the Commission, and is inserted in this volume. A preliminary chart was first prepared from information derived from a large number of published sources, chief among which were the article by Prof. Robert Liefmann in the 'Weltwirtschaftliches Archiv' for January 1913, various articles in the 'National Review' (London), the Mining and Engineering Review' (Melbourne), and other periodicals. The preliminary chart was then submitted for criticism to a number of Americans who are well informed in regard to the international metal situation and are acquainted with the organization, operation, and control of the companies shown on the chart. A final chart was then prepared, embodying the changes that were found to be desirable, in the light of the information gathered through such co-operation. The Commission believes that the chart herewith presented shows the principal companies and their inter-relationships, as they existed at the time of the outbreak of the present War. It is generally understood that as a result of the War there have already been a number of changes in such relationships, and that more are likely to take place.

It should be noted that the relationships shown on the chart indicate either stock control, stock inter-ownership, interlocking directorates, or syndicate connections. These relationships, the Commission is informed, are of such a nature that they lead to a centralized price control and to a harmony between the policies followed by the different companies in their purchases of metals. Connections also exist with other companies, but these have not been put on the chart because the Commission does not understand that they are effective in price control.

In the group of companies which are largely the outgrowth of the Merton concern, the dominating place has been held by the Metall Gesellschaft, the Metallbank und Metallurgische Gesellschaft, and the H. R. Merton & Co., Ltd. The affiliations of these companies through stock ownership and interlocking directorates is so close that it is difficult to determine which company is the dominating concern. The two largest subsidiary companies are the Merton Metallurgical Co. and the American Metal Co., Ltd. Apart from these two companies and their subsidiaries, the chart shows connections between the three controlling companies and 24 companies (excluding the Deutsche Gold- und Silberscheide group). Most of the connections were through stock ownership, either alone or in connection with interlocking directorates. In addition, mention is made of the fact that similar relations exist with 83 companies whose names are not separately shown.

While the chart shows 13 companies related to the central group through the American Metal Co., and a like number related through the Merton Metallurgical Co., attention should be called to the fact that many of these 28 companies are, at the same time, connected with one or more of the central group and with other companies directly connected with it. In all, the chart shows the names of 54 companies of the 137 companies (excluding the Deutsche Gold- und Silberscheide group), of whose inter-relation to the Metallgesellschaft the Commission has information. Among the important companies not mentioned on the chart in which the Metallbank und Metallurgische Gesellschaft holds shares are the Société des Anciens Etablissements 'Sopwith' of Paris and Linares, the bank of Delbrück Schickler & Co. of Berlin; the Mittledeutsche Versicherungs, A. G., Düsseldorf; the Allgemeine Revisions und Verwaltungs, A. G., Berlin; the Solotwina Naphta, G. m. b. H., Lemberg; the Osterr. Petroleum-Industrie, A. G., Vienna.

The Deutsche Gold- und Silberscheideanstalt. In 1872 the Deutsche Gold- und Silberscheideanstalt was established by the firms of Fr. Roessler Söhne and Hector Roessler, and in 1873 took over the precious metal business of Philipp Abraham Cohen. Close relations exist between the Merton interests and the Deutsche Gold- und Silberscheideanstalt, which is itself a widely ramified concern, is interested mainly in the chemical industry, and serves as the central agency for several cartels, among them the Convention of Manufacturers of Potassium Ferrocyanide, the Convention of Manufacturers of Potassium Cyanide, and the Convention for Quinine and Quinine Salts.

On the chart the connections in the nature of either stock-ownership, interlocking directorates, or both are shown between the Deutsche Gold- und Silberscheideanstalt and 20 minor companies. The direct connections shown are principally through stock-ownership. In addition to the connection shown on the chart with the Metallgesellschaft, the Commission has information concerning a number of inter-relations between companies of the Deutsche Gold- und Silberscheideanstalt group and those of the Metallgesellschaft, Metallbank und Metallurgische Gesellschaft, and H. R. Merton Co., Ltd., group, which it is not practicable to present diagrammatically.

Aron Hirsch und Sohn. The firm of Aron Hirsch und Sohn, of Halberstadt, is an important unit in the international metal trade around which numerous subsidiary and otherwise related companies are grouped. It is also closely associated with a number of German and international cartels. It is one of the three selling agencies of the international zinc syndicate of Germany. It is a member of the German Copper Sheet Syndicate, Cassel, and of the Combine of German Copper Wire

Works, Cologne. It holds an interest in the firm of Paul u. Siegbert Lachmann, the copper mine Ilsenberg am Harz, and the brass works Eberswalde on the Finow Canal. It controls the Hirsch, Kupfer- und Messingwerke, A. G., in Halberstadt (capital 10,000,000 marks), which manufactures chiefly copper and zinc products for railways, shipbuilding, and military purposes. The firm of Hirsch, Kupfer- und Messingwerke holds an interest in the Berlin Brass Works, Wilhelm Borchert, Jr., G. m. b. H. (capital 1,000,000 marks), and in the Rich. Herbig & Co., G. m. b. H., Berlin, and controls the Finow Metal Co., Ltd.

In Australia Aron Hirsch und Sohn are interested in such important metal enterprises as the Electrolytic Smelting & Refining Co. and the Mount Morgan Gold Mining Co., Ltd., one of the largest Australian copper-producing companies. Through the latter company Aron Hirsch und Sohn are connected by common directors with Goldsborough Mort & Co., bankers and brokers and with the Broken Hill Proprietary Block 10 Co., Ltd. The international ramifications of the Hirsch interests also extend to numerous companies in the United States and Mexico. The firm of Ludwig Vogelstein & Co., New York, of which the firm of Aron Hirsch und Sohn is a special partner, serves as intermediary between the Hirsch interests and several of the American companies. The chart shows the names of 19 companies which are connected directly or indirectly with the firm of Aron Hirsch through interlocking directorates or stock-holdings.

Beer, Sondheimer & Co. The firm of Beer, Sondheimer & Co., Frankfurt a. M., is the centre of another large group of enterprises in the international metal trade, and ranks next in importance to the Merton concern, with which it has certain interests in common. In 1906 Beer, Sondheimer & Co. founded the Tellus A. G. für Bergbau und Hüttenindustrie. This company in turn controls, through stock-ownership, or interlocking directorates, 36 other companies, the names of 12 of these concerns being shown on the chart. Beer, Sondheimer & Co. also are connected with the National Zinc Co. (New York), and the Elder's Metal Co., of Australia. The international character of its business is seen from the fact that in the group are German, Austrian, Italian, Belgian, French, American, and Australian companies.

The range of activities of the U. S. Bureau of Standards is shown by the recent annual report of the director, which states that 155,000 tests of weights, measures, and instruments were made during this year, a new standard screen-scale and new gauge-standards for testing munitions gauges was prepared, together with investigations covering the accuracy of leather-measuring apparatus, standardization of blood-counting apparatus, standardization of master scales in 21 States and of those used by the American Railway Association, extension of the work on altitude-measuring instruments including those used in aviation, and also special researches in the physics of materials.

Electrolytic Zinc

In making electrolytic zinc, according to Joseph W. Richards, the presence of manganese in the solution is of advantage during electrolysis; in fact, at the electrolytic plant at Nelson, B. C., a manganese salt is said to be added to the solution because of its beneficial action during the electrolysis. The manganese separates out on the anodes as manganese di-oxide, helping to prolong their life and also furnishing indirectly a method of extracting the manganese from the raw materials used in the manufacture of the soluble manganese salt. It is quite true, however, that small amounts of certain impurities render difficult the deposition of the zinc in coherent form, and great care must be taken to maintain the purity of the electrolyte. He takes exception to the statement that all the factors necessary to the production of electrolytic zinc were known long ago. One of the most important factors recently determined is the extent to which the zinc can be extracted from the solution, leaving the solution acid. Many thousands of dollars have been spent in experiments during the last few years to determine just how far the electrolysis can proceed and the acidity of the solution be increased without decreasing too much the deposition of the zinc. He thinks that not enough emphasis has been placed on the possibility of the electrolytic methods replacing the retort methods for zinc. He bases his prediction on the fact that the retort methods have been used for over a hundred years and at the present time are being only very slowly improved, whereas the electrolytic methods have been in use not more than five years and are susceptible of very much greater improvement. He thinks that where one may expect a possible improvement of 10% in the retort processes in, let us say, the next five years, there is a possibility of an improvement of perhaps 50% in the electrolytic processes. One must not overlook the possibility of a relatively much greater improvement in the new electrolytic methods, and he affirms that the Joplin territory will very soon see an invasion of electrolytic zinc, as has been pointed out, for their special concentrates or special kinds of ore.—Amer. Inst. Min. Eng.

Alaskan mines are believed to have produced gold to the value of about $15,450,000 in 1917, compared with $17,240,000 in 1916. The total value of the gold mined in the Territory is now about $293,500,000, of which $207,000,000 has been won from placers. In 1917 about 88,200,000 lb. of copper was produced in Alaska, valued at about $24,000,000. The production in 1916 was 119,600,000 lb., valued at $29,480,000. The total copper produced to date is 427,700,000 lb., valued at $88,400,000.

Pyrites from domestic sources is now quoted at 25 to 30c. per unit of contained sulphur. Spanish pyrites is still quoted at 16c. per unit, but foreign prices are based on the freight rates. The seller pays up to 13 shillings and the buyer the difference. Freights today are from 30 to 35 shillings per ton.

California Metal Production in 1917

The mines of California made an output in gold, silver, copper, lead, and zinc, valued in all at $41,457,692 in 1917, compared with $39,749,263 in 1916, according to preliminary figures compiled by Charles G. Yale of the San Francisco office of the U. S. Geological Survey. This is an increase of $1,708,429.

The mine output of gold in 1916 was $21,410,741. The estimated output of gold in 1917 is $21,098,915, a decrease of $311,826. If this estimate is correct, the slight decline in the gold output of the State in 1917 as compared with 1916 is much less than has been expected in view of conditions that have existed since the United States entered the War. These conditions have affected the deep mines more unfavorably than the placer mines. There has been, and still is, a scarcity of skilled labor, as machine-men, timber-men, and skilled miners have been attracted elsewhere by the higher wages paid in munition factories, copper and coal mines, and other industries that supply demands made urgent by the War.

The higher cost of nearly all mining supplies, and the increased taxation have made it impossible to operate at a profit some of the large mines that have been working low-grade ore. A number of the smaller mines have therefore already been closed, and some of the larger ones will stop ore-producing and milling ore this winter, and will do development work only and keep down the water. Some operators say that the purchasing power of gold has so greatly declined that they are virtually getting only about $10 an ounce for their gold. Meetings were held in San Francisco in December by the prominent gold operators to protest against any discrimination through freight priorities aimed at the mining of gold as non-essential to the conduct of the War. It was feared also that the supply of explosives for use in mining might be cut off on the same ground. These apprehensions and the existing conditions have caused great unrest among gold miners, and as a result prospecting and development have almost stopped.

The deep mines of California are now producing about 60% of the gold output of the State, the other 40% coming from the various placer mines, principally through dredging. The proportion of the gold output of the State derived from placers is thus increasing. The gold-dredging industry continues prosperous, and few changes have occurred in the general conditions. In all the larger enterprises a greater effort is being made to save more gold. A few dredges are re-working old tailings with profit. Some of the largest and most expensive dredges ever built have been put to work in 1917. A number of old dredges have been dismantled and their machinery has been put into boats for use at new places. A few have gone out of commission altogether, their available ground having been worked out. Some new machines have been installed on new ground in the 'outside' districts of the State. Neither hydraulic nor drift mining shows any marked revival, though several old hydraulic mines that have been idle for more than a quarter of a century have been re-opened, and search is being made for available ground where conditions are favorable for constructing the dams and basins required for impounding the débris.

The output of silver is estimated at 2,144,196 oz., valued at $1,745,375, as compared with 2,564,354 oz., valued at $1,687,345 in 1916. This silver was derived mainly from copper and lead ores, although some is mined with the gold. Owing to the rise in value of silver, a number of old mines in San Bernardino and Inyo counties that were once worked profitably, but that for years have been idle, are now being re-opened. Notable among these are the mines at Calico, which were at one time large producers. None of these properties, however, yielded much silver in 1917.

The estimated mine output of copper is 57,591,195 lb., valued at $15,664,805, as compared with 55,897,118 lb., valued at $13,750,691 in 1916. Labor troubles during the year restricted somewhat the output of the most productive copper mines in the State, and thus affected the total. Shasta county was by far the largest producer in 1917, but Calaveras, Placer, and Plumas counties now have very productive mines, with their own reduction plants, and there are many smaller productive copper mines in other counties.

The output of lead in 1916 was 12,407,493 lb., valued at $856,117; the estimated output in 1917 is 23,189,974 lb., valued at $2,133,460. Nearly all the lead comes from Inyo, San Bernardino, and other counties in the southern part of the State.

The estimated output of zinc in 1917 is 9,158,851 lb., valued at $815,137, as compared with 15,256,485 lb., valued at $2,044,369 in 1916. The zinc comes entirely from Shasta and Inyo counties. Every one of the larger companies made a reduced output in 1917.

Alaskan Mineral Output in 1917

In 1917 Alaska produced minerals valued at $41,760,000, as determined by an advance estimate by G. C. Martin of the U. S. Geological Survey. This is about $6,870,000 less than that in 1916. The leading product was copper, being 88,200,000 lb., valued at $24,000,000. This is less than the output of 1916, which was 119,600,000 lb., valued at $29,480,000, but is greater than that of any other year. The reduction is due largely to labor troubles, and is not necessarily permanent. The gold production was $15,450,000, of which $9,850,000 was derived from placer mines. The reduction from $17,240,000 in 1916 was due chiefly to curtailment due to the scarcity of labor and the high cost of materials, but, in part, to the disaster at the Treadwell mine and the depletion of some of the richer placers. Alaska also produced silver, valued at $1,050,000, coal worth $300,000, lead $160,000, tin $160,000, antimony $40,000, and tungsten, chromium, petroleum, marble, gypsum, graphite, and platinum, valued at $600,000.

Mining in the North-West

By FRANCIS A. THOMSON

While there may have been slightly less activity during 1917 than in 1916, the year as a whole has been a prosperous one in the North-West. Changes in market conditions and in the labor situation brought about by our entry into the War have disturbed operations, but the situation as a whole, provided relief from the war-tax is secured, is fairly promising.

The supply of labor has been reasonably adequate. The lead-gold-silver mines are having to pay a price dictated largely by conditions in the copper districts, without the compensation of a fixed price at a fairly high level. The miners, however, have shown less disposition to listen to anarchism and the I. W. W. than the workmen in other industries.

The extension of smelting facilities at Northport and the entrance of the Bunker Hill & Sullivan company into the ore-market have been favorable features for the lead-gold-silver mines. The closing of the Trail smelter across the line and the reduced scale of operations at the B. C. smelter at Greenwood and at the Granby plant at Grand Forks due to coke shortage have hurt the small copper producers.

No material change in transportation facilities has taken place, if we except the Pine Creek branch of the O. W. R. & N., which will afford an outlet for the promising zinc-lead producers of this comparatively new district of the Coeur d'Alene region.

In the line of legislation the outstanding feature of the year is, of course, the War Tax law, which, because of its inequities and "inartificialities," as Judge Turner's pleasant euphemism has it, promises to bear with great harshness on those concerns which have been commendably conservative in the matter of capitalization. Doubtless relief will come in time, but meanwhile some of the mining companies are having to cancel dividends to stockholders in order to declare them in favor of the tax-gatherer. Against this the mine-owners would not protest if they felt that all other concerns were carrying an equal load. A second line of Federal legislation that directly affects the mining industry is the Explosives Act. This is designed to prevent explosives falling into the hands of alien enemies and is a highly commendable piece of legislation. The administration of the law is placed in the hands of the Director of the Bureau of Mines, who is given full authority for carrying out its provisions. The fear that the administration of the act might result in restriction of mining operations does not seem justified.

The year has been singularly devoid of new discoveries. Several of the larger properties in the Coeur d'Alene have responded favorably to new development, and the Pine Creek district should soon begin to make a place for itself in the zinc and lead statistics.

An interesting innovation is the dredging operation that the Yukon Gold company is beginning near Murray on the north fork of the Coeur d'Alene river, one of the Yukon boats having been 'transplanted' for the purpose.

In Stevens county the continued development of the great magnesite deposits and the erection of kilns, with the steady shipment of both calcined and raw products, continues to be a gratifying feature of the contribution that our mineral deposits are making to the War. At Loon Lake, also in Stevens county, development of copper prospects long known but little valued is proceeding with encouraging results. In a small way the same thing is true of the copper prospects in the Hoodoo district of Latah county. Good reports continue to come in from the Marshall Lake district in central Idaho, and several other quartz properties in this once famous placer locality are giving evidence of new life.

The outstanding feature in metallurgical construction is the Bunker Hill & Sullivan smelter. Designed by the most experienced firm of smelter engineers in the West, and with the greatest silver-lead mine in the world to supply the wherewithal, it stands as the last word in this type of construction. Of steel and concrete throughout, it affords a startling contrast to the older plants, which, like Topsy, have "just growed" in response to an ever-varying ore-supply. From automatic charge-weighing hoppers to refinery, and from Dwight-Lloyd roasters to bag-house and Cottrell plant, everything is as complete as money and brains can make it.

Flotation continues to find wider application, the tendency being about equally divided between pneumatic and agitation machines of various types; and so far the Minerals Separation company seems disposed to content itself with an occasional circular letter to the operators.

To the student of mining litigation the year has been unusually interesting, there having been three major cases, each of a different character, involving in turn the three greatest properties of the Coeur d'Alene. First is the suit of the American Smelting & Refining Co. against the Bunker Hill & Sullivan company, by which the former claims breach of contract and seeks to prevent the latter from treating its own ore in its own smelter. From the appearance of things at the new smelter it is evident that the owners of the Kellogg plant have no expectation of being put out of business. The next suit in point of interest is the apex litigation of Star *v.* Federal, involving ownership of orebodies adjacent to the Morning mine at Mullan. As in most cases of the kind, the public has been highly edified by the startling differences of

opinion among eminent members of the mining profession upon matters where substantial unanimity would be expected. The man in the street begins to wonder whether economic determinism has not become a controlling factor among the adherents of a certain school of geological opinion. Like other defects in our system of litigation, the matter of ex parte expert testimony has waited long for remedy. Decision on this case has not yet been rendered; the orebodies in question are extensive and valuable and the future of each of the parties to the suit depends to a considerable extent on the outcome. Either a comparatively unknown prospect will at once become a big mine or the Star company will lapse back into obscurity and the great Morning mine will pursue the even tenor of its way. The last great suit of the year is that of Cardoner *v.* Day for annulment of sale on grounds of alleged fiduciary relationship between buyer and seller, and of inadequacy of consideration. Late in 1916 Mrs. Cardoner received $375,000 for her one-sixteenth interest in the Hercules mine. Testimony concerning the value of the property involving principles of mine-valuation was offered by defendants themselves and by their engineer to the effect that the present value of the property was approximately $5,000,000, on which basis Mrs. Cardoner received a fair consideration for her interest. Mrs. Cardoner's engineer places the value of the total ore in the mine at $10,750,000 and assigned a life of 13¾ years to this amount of ore at present production. The present value of this amount of ore distributed over 13¾ years at any rate of interest between 7 and 10% is from $4,500,000 to $5,000,000. This corroborates the testimony of the defense. Decision is expected any day.

The effect of the War on mining is disquieting. The demand for lead is sluggish, due doubtless to a cessation of normal construction and painting demands, to the fact that ammunition is being made largely in England, and that lead supplies for this are presumably coming from Spain and Australia. In zinc the situation is disquieting, partly because England is becoming a large producer from Australian ores, and at the Government price for copper many of the smaller producers are not making much money. We are getting subnormal prices for the metal and paying abnormal prices for labor and supplies. Having been smitten on this cheek, Uncle Samuel asks us to turn the other one and let him swat us with an ill-considered war-tax. The possibility of dollar silver is the one ray of hope on the horizon of the coming year.

In conclusion, lest this be considered a tale of woe, let me say from an intimate contact with the mining industry of this part of the North-West, that those responible for the productive operations are not only able and willing, but even anxious, to carry their share of the war load. They are giving their valued technical men to the Army, they are subscribing and over-subscribing to Liberty loans, and they are donating to 'drives' without stint. As one operator put it a few weeks ago, "Uncle Sam can have all we've got if it's necessary in order to lick the Kaiser, he can take our mines and our mills if need be, and we'll live on turnips and carrots if Hoover says so, but at the same time we expect the other industries to tote their fair share of the load."

Mineral Production in South Africa

The value of all the minerals produced in the Union of South Africa for the month of August amounted to $17,569,277. The gold production was 757,202 fine ounces, valued at $15,652,557, of which the Transvaal alone yielded 757,146 fine ounces, worth $15,651,404. The Union also produced 944,757 tons of coal, worth at the pit's mouth $1,435,019, of which the Transvaal contributed 618,314 tons, worth $717,342, and the Orange Free State 76,833 tons, valued at $96,259. The copper production of the Union amounted to 593 tons, valued at $142,720. Out of 225 tons of tin produced, the Transvaal supplied 223 tons, worth $167,904. The profit earned by the Transvaal gold mines in August fell to $4,287,387. With the exception of that for February, the return is the lowest for this year, and compared with August 1916 it is a reduction in profits amounting to $574,247. However, the Rand companies show a profit of $34,084,966 for the eight months of the present year. During the past year working-costs have advanced on the Transvaal gold mines from $4.38 to $4.66, of which 12c. per ton has been neutralized by higher recovery. It is noticeable, however, that the tonnage handled is 126,000 lower than a year ago. In August the Rand output amounted to $15,111,930, equal to $6.51 per ton; working-profits were $4,182,839, representing $1.82 per ton. The general aggregate was severely affected by the poor profits of certain mines in the Germiston district, but fortunately the splendid progress of the Far Eastern Rand was more than maintained. The 10 mines of that district show profits totaling $2,034,197, or nearly half the profits of the whole Rand. Eight of these mines made a profit of over $2.43 per ton, while four returned over $486,500 worth of gold. The total mineral production of Southern Rhodesia for August amounted to $1,789,076. Of this, the output of gold reached 70,259 fine ounces, worth $1,432,499, and the yield of silver was 17,768 oz., worth $10,886.

The Federal Aid Road Act is benefiting all the States of the Union. The appropriation was 75 million dollars for the construction of post-roads and 10 million for forest-roads. In 1916 there were approximately 41 million dollars of State funds expended for all highway purposes, and it is estimated that in the calendar year 1917, the aggregate expenditures of State funds for this purpose will be at least 60 millions. A number of the States have made appropriations to meet the Federal aid dollar for dollar. Further information regarding this work may be obtained from the Director of the Office of Public Roads of the Department of Agriculture.

Nevada Mine Output in 1917

The value of the gold, silver, copper, lead, and zinc mined in Nevada in 1917 was over $53,000,000, according to preliminary figures compiled by Victor C. Heikes of the U. S. Geological Survey. This total represents an increase of over $3,000,000 in spite of the fact that there was a slight decrease in recoverable zinc and a marked decrease in both gold and silver. There was a fair increase in the output of both copper and lead. The average prices of silver, copper, and lead were unusually high in 1917, and this fact had much to do with making the total value greater than that of the previous year.

The gold output of Nevada was valued at about $6,852,000, a decrease of about $2,000,000. This decrease was due in great part to the reduced output of the Goldfield Consolidated Mining Co., which has for years been the main gold-producer of the State. The production of the Tonopah district, the ores of which contain considerable gold, was also less. The gold output was valued at about $1,612,000, against $1,941,441 in 1916. The main producers were the Tonopah Belmont, Tonopah Mining Co., Jim Butler, Tonopah Extension, and West End. Much gold came from the Elko Prince, the Aurora Consolidated at Aurora, the Round Mountain placer and quartz properties, the Rochester district, and the mines at Manhattan, where there was renewed activity. At the White Caps mine a large orebody is developed from five levels. The new mill, with roaster, was active during the last part of the year, making a considerable output. The War Eagle, Big Pine, and Union Amalgamated mills were also operated, and a large amount of placer gravel was treated by 12 operators. Bullion production from Seven Troughs district decreased, as did the placer output from the Battle Mountain district of Lander county, but the mills in Eldorado canyon, in Clark county, were unusually active. The National mine, a large producer in the past, was unproductive in 1917. About one-sixth of the gold came from copper ore and lead ore, mainly from copper ore.

The production of silver decreased from 13,837,525 oz. in 1916 to about 11,394,000 oz. in 1917. The price of silver, which averaged about 81 cents per ounce, gave this output a value of $9,229,000, which is slightly more than in 1916. The principal silver-producers were the mines at Tonopah, the Nevada Wonder, the Rochester Mines Co., Nevada Packard, Elko Prince, Comstock properties, Yellow Pine, and Nevada Hills. With the improved price it was possible to treat low-grade ore, especially at Tonopah, where the silver output decreased to about 7,500,000 oz. from 8,734,726 oz. in 1916. The Tonopah Belmont, Tonopah Mining, and Tonopah Extension each produced more than 1,000,000 oz. of silver as well as considerable gold. The Mexican mill at Virginia City treated custom ore, largely from the Union Consolidated mine, but the bullion output of the district was much less.

The copper production of Nevada increased to nearly 110,000,000 lb., an increase of nearly 5,000,000 lb. over that of the previous year. The value of the output increased from $25,858,736 to about $32,000,000. The main copper-producer, as formerly, was the Nevada Consolidated at McGill. This company was milling over 300,000 tons of ore per month and shipped a first-class product. The production from the smelter was somewhat less than in 1916, but the loss was more than compensated by the operation of the Mason Valley plant, in Lyon county. A large part of the ore treated came from the Bluestone mine, considerable quantities of copper ore were shipped to other copper plants, especially from the Yerington district in Lyon county, the Santa Fe and Silver Star districts of Mineral county, and from the Robinson district in the vicinity of Ely. The Copper Canyon Mining Co., in the Battle Mountain district, made a large output. The Consolidated Copper Mines Co., at Ely, contributed a noteworthy quantity of both crude ore and concentrates. The mill was remodeled and improved, and toward the close of the year treated more than 600 tons per day.

The production of lead increased from 25,637,278 lb. in 1916 to over 28,000,000 lb. in 1917. The value of the output increased from $1,768,972 to about $2,537,000. The principal lead-producing districts are the Pioche of Lincoln county, particularly the Prince Consolidated mine, and the Yellow Pine district of Clark county. The Bullion and Goodsprings Anchor properties, in the Yellow Pine district increased their output of lead. Considerable ore was mined at the Groom property, in southwestern Lincoln county, at the Hamburg property near Pioche, at the Union Mines Co., and at properties in the Eureka district of Eureka county.

There was a decrease in the production of recoverable zinc from 32,443,189 lb. in 1916 to about 28,500,000 lb. in 1917. The value of this output decreased considerably from over $4,000,000 to about $2,613,000. The Yellow Pine property, in Clark county, continued to supply the largest quantity of zinc produced by any mine in the State. The Potosi mine of the Empire Zinc Co. was also a large producer. Zinc was also produced by the Nevada Zinc Mining Co. in Elko county, the Lone Mountain district in Esmeralda county, and Ely in White Pine county.

The dividends declared by Nevada mining companies in 1917 amounted to over $11,000,000. The largest was that of the Nevada Consolidated, which paid over $8,000,000. Others were the Tonopah Belmont, Tonopah Mining Company, Jim Butler, Yellow Pine, Nevada Hills, Tonopah Extension, Boss, West End, Hamburg, Nevada Wonder, Uvada, Rescue Eula, and Prince Consolidated.

LITHOPHONE manufacturers are so far sold out that they are reported to be withdrawing from the market. The market is strong, with prices advanced as high as 7c. per pound, and predictions are for still higher figures. Prices of zinc oxide are also good, spot commanding 12½ to 14c. Producers are sold out three months ahead, with contract prices at 14c. for white seal, and 13c. for red seal.

Metal Mining in Montana in 1917

The value of the gold, silver, copper, lead, and zinc mined in Montana in 1917, according to the estimate of Victor C. Heikes of the U. S. Geological Survey, was nearly $113,000,000, a decrease of more than $20,000,000 from the value in 1916. There was an increase in the production of lead in the State, but a marked decrease in that of gold, silver, copper, and zinc. The mines at Butte and the smelters at Anaconda and Great Falls were idle two months on account of labor strikes. The prices of metals, except zinc, were unusually high. The cost of labor and material was also high.

The gold mined was valued at $3,371,000, as compared with $4,550,494 in 1916. The decrease in the output of copper ore reduced the output of both gold and silver. A marked decrease was also recorded in the gold won by dredges at Alder Gulch. There was an increase in gold bullion from the Barnes King properties, especially the Shannon mine at Marysville. Some bullion came from the new mill of the Bannack Gold Mining Co., at Bannack, in Beaverhead county. There was considerable activity in the Warm Springs district of Fergus county.

The output of silver decreased from 16,494,366 oz. in 1916 to about 12,788,000 oz. in 1917. In spite of the increased price, the value ($10,358,000) was nearly $500,000 less than in 1916. Nearly all the silver is derived from copper ore, the production of which decreased for the year.

The output of copper in 1917 was about 278,000,000 lb., a decrease of nearly 75,000,000 lb. The value of the output was about $81,000,000, against nearly $87,000,000 in 1916. Practically all the larger copper producers made a smaller output than during former years, especially the Anaconda and North Butte. On the other hand, there was a slight increase from East Butte. In March the Anaconda plants produced over 31,000,000 lb. of copper. Had this rate continued for the year, Montana would have had a largely increased copper output, but the industry was seriously affected by the closing of the mines and plants in July, August, and part of September. Shipments were made from the Tuolumne, Davis Daly, and Bullwhacker mines, and a good output came from the Butte & Duluth leaching plant.

The mine output of lead increased from 13,595,136 lb. in 1916 to about 17,000,000 lb. in 1917. The price of lead evidently stimulated work on many of the lower-grade lead mines. The lead concentrate from lead-zinc ore was less, however, on account of the decrease at the large zinc mines. At Troy, in Lincoln county, the new mill of the Snowstorm Mines Co. was producing both lead and zinc concentrate in July, and marketed considerable quantities of both products. The Valley Forge mine, in Lewis and Clark county, shipped much lead ore to Helena for concentration.

The output of recoverable zinc from Montana amounted to about 180,000,000 lb., against 229,259,075 lb. in 1916. Prices were lower in 1917, but the decrease was also due in part to labor troubles and to a lawsuit between the two chief zinc-producers of the Butte region. During the first quarter of 1917 the Butte & Superior Mining Co. produced over 40,000,000 lb. of gross zinc, but it did not maintain this rate of production throughout the year. The Elm Orlu produced some ore but considerably less than in 1916. The rest of the output of the State came from the mines of the Anaconda company, the product of which is leached at Great Falls after being concentrated. Other shipments of zinc were made from the Snowstorm at Troy and the North Butte at Butte.

The dividends for 11 months amounted to over $23,000,000. The principal dividend-payers were the Anaconda, Butte & Superior, North Butte, East Butte, Barnes King, and Butte-Bullwhacker.

Oregon Metal Production in 1917

A preliminary estimate of the production of metals from Oregon mines in 1917, compiled by Charles G. Yale, of the San Francisco office of the U. S. Geological Survey, shows a material decrease from that of 1916. The output of gold in 1916 was $1,902,149, and the estimated output in 1917 is $1,466,419, a decrease of $435,760. The output of silver in 1916 was 231,342 oz., valued at $152,223, and the estimated output in 1917 is 115,697 oz., a decrease of 115,645 oz. in quantity and $58,046 in value. The output of copper in 1916 was 3,501,886 lb., valued at $881,144, and the estimated output in 1917 is 1,508,639 lb., valued at $410,349. A small quantity of lead was produced in 1916, but no production of this metal has been reported for 1917.

There are about a hundred productive mines in Oregon, and although two-thirds of them are placer mines, the larger part of the output of gold comes from the deep mines, and, of course, virtually all the output of the other metals. There were no important discoveries in any of the mining districts of Oregon in 1917, and no great increase in the output of any of the more productive properties. The entire output of ore from all the deep mines combined does not exceed 160,000 tons. Most of the placer mines are worked by the hydraulic system, but the three dredges now in use produce far more gold than all the other placer operations combined. The largest output of gold and other metals in 1917 came, as usual, from Baker county, which produces annually about 90% of all the gold mined in the State, Josephine county is next in production.

ZIRCONIUM minerals are chiefly used as a refractory material. The linear co-efficient of expansion of pure fused zirconia is 0.00000084. It is not only heat-resisting, but does not react as a flux to form slag. It is particularly desirable for laboratory refractory ware, such as crucibles, muffles, combustion tubes, resistance cores, and the like. Zirconia has a low conductivity, and refractory ware made of it must be thin-walled.



TONOPAH, NEVADA

TONOPAH MINING.—TONOPAH EXTENSION.—TONOPAH BELMONT.—WEST END CON.—JIM BUTLER.

The Tonopah Mining Co. continues to ship ore from the old dumps at the rate of 2500 tons per week to the plant at Millers. Commencing the first of the year about 150 tons of mine ore is being shipped to the Belmont mill daily. Arrangements have been made whereby the production of the Tonopah Mining Co. will be treated at the Belmont mill when the production does not justify the operation of the 100-stamp mill at Millers. During the past week 2400 tons of ore was milled, averaging $10 per ton. At the Silver Top 32 ft. of development has been done and 42 ft. at the Sandgrass. At the Silver Top on the 340-ft. level the raise on the Burro No. 2 vein shows an increase in width and value. A raise has been started on the Upper Sandgrass vein from the 1140-ft. level of the Sandgrass. Last week's production was 2900 tons.——The Tonopah Extension Mining Co. shipped 24 bars of bullion valued at $55,264. At the No. 2 shaft 90 ft. of development has been done and 169 ft. at the Victor. At the No. 2 shaft on the 1260-ft. level raise No. 450 was advanced 35 ft. on a 3-ft. face of ore. On the 1350-ft. level raise No. 567 continued in good ore and holed through into the level above. On the 1680-ft. level of the Victor the 1600 east drift advanced on a 4-ft. face of ore, while the 1600 west drift continues on a 6-ft. face of ore. The 1600 south cross-cut made 58 ft. of progress. The production the past week was 2380 tons.——The Tonopah Belmont Development Co. will operate its mill at capacity, as arrangements have been made to handle all the ore from the Jim Butler Tonopah Mining Co. and part of the Tonopah Mining Co. output. On the 700-ft. level east drift No. 721 on the Shoestring vein shows 1½ ft. of ore. Raise No. 8 from drift No. 721 is making good progress on the Shoestring vein. On the 800-ft. level east drift No. 8017 on the South vein struck a fault; but the vein was recovered. The west drift No. 8018 also struck a fault. On the 1100-ft. level raise No. 94 on the Western vein continues on a 1½-ft. face of medium-grade ore. Last week's production was 2285 tons.——The West End Consolidated Mining Co. shipped 40 bars of bullion valued at $74,061. Driving to the west in drift No. 535 continues in a full face of excellent ore. Winze No. 534 is progressing in ore. Raise No. 814 has reached the foot-wall of the vein. The output the past week was 1247 tons. At the Halifax Tonopah Mining Co. the 1018 cross-cut struck a small vein. Work has been suspended in the 1708 cross-cut awaiting the erection of a larger fan.——The Jim Butler Tonopah Mining Co. produced 746 tons of ore. On the 200-ft. level of the Wandering Boy raise No. 373 continues on a 3-ft. face of medium-grade ore. On the intermediate at the Desert Queen raise No. 654 uncovered ore.—— The MacNamara Mining Co. shipped seven bars of bullion valued at $11,700. Work in the raise on the 700-ft. level has been suspended for the present, and work in the west cross-cut has been resumed to allow for the exploration of the vein by raises. The production the past week was 517 tons.—— With the completon of shaft repairs, work has been resumed in the raise from the 800-ft. level of the Monarch Pittsburg Mining Co.——The Montana produced 42 tons, and miscellaneous 61 tons, making the week's production at Tonopah 10,178 tons with a gross value of $187,115.——During the past year the mines at Tonopah produced 485,000 tons of ore, having an approximate value of $8,640,000. During the period $1,870,309 was paid in dividends making the total dividends to date $30,559,548.

MAMMOTH, UTAH

TINTIC STANDARD.—EUREKA LILY.—TINTIC DELAWARE.—ORE SHIPMENTS.—IRON KING.

At the Colorado Consolidated, which is a consolidation of the Colorado and Beck Tunnel mines, prospecting is being done on the 1100-ft. level, where a drift is being driven toward the south-east.——At the Zuma work is being carried on in the winze as well as in the cross-cut on the 500-ft. level. In both places the showing is satisfactory.——The shaft at the Copper Leaf Mining Co., which has been cutting through an exceedingly hard formation, is now in softer rock and much better progress is being made. The shaft is down 430 ft.——J. H. McNellis of Silver City, who is superintendent for the new owners of the Scotia property of West Tintic, states that the new machinery is now in place and that the development of the mine will be under way within the next week. It is the intention of the owners to thoroughly prospect the upper workings of the mine and if necessary go deeper with the main working shaft. The new equipment consists of a 12 by 12 compressor, a 30-hp. gasoline hoist, and a new cage. The shaft has been re-timbered.——The Tintic Standard is shipping two carloads of first-class ore daily. If cars can be secured the Standard will be able to ship at the rate of 100 tons of ore daily. In the newer workings north-east of the shaft, and also in the older part of the mine an immense tonnage of ore is exposed and the property promises to be one of the big producers of the district during 1918.——At the Eureka Lily mine, where the gas has been interfering with the work, a connection has been made which has relieved the situation. On the 1400-ft. level of the Eureka Lily drifts are now following two important veins and later raising will be started for the purpose of following a bunch of ore above the 1400-ft. The work is being carried on in a big mineralized area similar to that existing in the neighboring mine and it is hoped that only a little work will be needed to bring the mine into the productive stage.——The orebody of the Tintic Delaware is increasing with depth. This is being demonstrated by developments in the new workings, where carbonates are being replaced by sulphides in the bottom of the winze, which is now down 15 ft. For some time past the company has been developing a big body of high-grade lead-silver ore in the face of the adit and the work has demonstrated the deposit to be at least 30 ft. wide. Assays from the face ran up to 82% lead and 8 to 10 oz. silver. It is planned to sink the winze to a depth of 50 ft. to prove the permanency of the orebody.——The total shipments of first-class ore from this district amounts to 169 carloads as compared with 118 for the previous week. The principal shippers were Dragon Consolidated 43 cars, Chief Consolidated 18, Eagle & Blue Bell 17, Iron Blossom 16, Grand Central 15, Centennial Eureka 13, Mammoth 11, Tintic Standard 10, Gold Chain 5, Empire Mines 5, Victor 4, Colorado

2, Scranton 2, other mines 8 cars, making the total 169.——A short time ago a trial shipment of iron ore was sent out from the Iron King property in the eastern end of the Tintic district and following the arrival of this ore at the smelter a satisfactory contract has been signed permitting the shipment of several hundred tons of the same character of ore which is now on the dump at the mine. The contract for the hauling of this ore between the mine and the railroad has been awarded to the Robertson Brothers of Eureka. There is an extensive supply of iron ore at the property and in the event of a railroad being built into that section the ore would be valuable to the company.

PLATTEVILLE, WISCONSIN

Blende, Galena, and Pyrite Prices.—Ore and Concentrate Shipments.

The month of December compares favorably with the records shown for other months of the year when operating conditions were far more favorable to the miner. Severe cold and heavy snow falls followed by windy spells obliterated roads and completely isolated many strong producers, making deliveries of zinc ore at times out of the question. To further cripple transportation facilities, at best none too good, for several months 20 engines were removed from the Galena division of the Northwestern Railway under orders of the War Department. This line gives immediate service to every mining district in the field and the carrying out of the order impaired the railway service so seriously that many small operating companies were compelled to suspend operations for the remainder of the winter. Price offerings while more nearly in adjustment with the price of spelter were regarded as unsatisfactory by miners because of the excessive cost of operating. Powder is now being sold at $500 per ton; steel and all other essential supplies used in zinc-ore mining are from two to five times higher than they were two years ago, and labor also is much higher. There being no possible chance for lower prices of raw materials it follows that unless zinc-ore producers soon receive better prices for their ore many companies will be unable to continue and shut-downs are anticipated in every district of the entire field. Labor conditions showed considerable improvement through the month.

Prices for zinc ore were badly upset during the whole month, the base being given at the beginning of the month at $62 per ton for top grades with the range down to $57 for second and medium grades. Inquiry among buyers and sellers revealed a wide disparity in figures, the Linden district showing a base of $58 per ton for 60% ore free from lime and lead. Cuba City operators reported the same base but gave additional figures of an interesting nature, 55% ore selling at $44, 50% at $40, 45% at $34, 40% at $30, 35% at $26.50, and 30% at $22.

Lead-ore producers persisted in their campaign of seclusion for the entire month, such ore as was sold coming for the greater part from the mines of the New Jersey Zinc Co. and being delivered to the company's own smelter at Palmerton, New Jersey. The regular quotation of $75 per ton for 80% material did not apply, therefore, on the lead ore sent East and producers not so situated refused to sell their product at the prevailing quotation. Production was good considering the difficulties milling plants experienced during the greater part of the month from frozen intakes, mill reservoirs, and pipe connections. The reserve conservatively estimated at the beginning of the month at not less than 2000 tons all-lead concentrate was appreciably increased during December and yet operators courageously express the belief that better prices for ore are bound to develop before long.

Shipments of pyrites during the month were restricted because of the growing scarcity of cars for prompt loading of zinc ore. The increased handling of low-grade pyritic ores at refineries is responsible for increased stocks of fine pyrites at separating plants and one firm alone reported a reserve stock in excess of 2500 tons. It would appear to the close observer that there is then held in the field at present not less than 5000 tons of this commodity. Such sales as were made were contingent upon contract arrangements and the price was not regarded as satisfactory.

Shipments of zinc ore from mines to refineries in the field and from mines to smelters direct and other ores made during December were:

Districts	Zinc lb.	Lead lb.	Pyrites lb.
Benton	24,036,000	402,000	286,000
Mifflin	6,318,000	.....	.....
Galena	2,610,000	186,000	.....
Shullsburg	2,066,000	220,000	.....
Linden	2,046,000	146,000	80,000
Platteville	818,000	.....	.....
Highland	712,000	60,000	.....
Hazel Green	710,000	.....	.....
Dodgeville	600,000	.....	.....
Cuba City	408,000	.....	2,298,000
Mineral Point	190,000	.....	.....
Totals	40,522,000	1,014,000	2,664,000

Shipments of the high-grade refined product from separating plants were:

	Lb.
Mineral Point Zinc Co.	6,142,000
Skinner Roasters (Wisconsin Zinc Co.)	6,014,000
National Separators	3,100,000
Linden Zinc Co.	674,000
Benton Roasters	568,000
Total	16,498,000

The recovery of mine run for the month amounted to 20,258 short tons; total net deliveries out of the field 13,953 tons. On distribution the Mineral Point Zinc Co. continued its hold on first place with receipts of 169 cars, 6297 tons; Grasselli Chemical Co. 137 cars, 5250 tons; Wisconsin Zinc Co. 100 cars, 3997 tons; National Separators 82 cars, 3468 tons; American Zinc Co. 44 cars, 1879 tons; M. & H. Zinc Co., La Salle 40 cars, 1599 tons; Linden Zinc Co. 24 cars, 889 tons; Illinois Zinc Co. 12 cars, 538 tons; Lanyon Zinc Co. 12 cars, 464 tons; Benton Roasters 9 cars, 379 tons; American Metals Co. 8 cars, 366 tons; and Edgar Zinc Co. 6 cars, 201 tons.

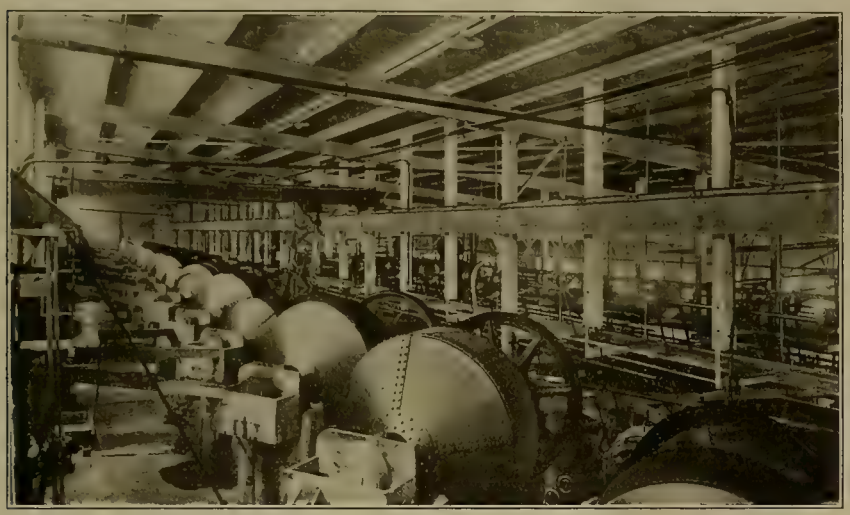
The principal operating firms in this field have had several mines under the one management for the past ten years. These groups are collectively the source of a major portion of the total recovery of zinc ore each month. For December the Vinegar Hill Zinc Co. delivered 106 cars, 4272 tons of zinc-ore concentrate. The Wisconsin Zinc Co. was a close second, delivering to the Skinner Roasters 100 cars, 4047 tons. The Mineral Point Zinc Co. was third, shipping from its own mines 96 cars, 3680 tons, to Mineral Point. The Frontier Mining Co. sent out 78 cars, 3019 tons, but shipments for December from this group of producers has been lighter than in several months preceding owing to bad roads and to the fact that several of its best producers are considerable distances from the railroad.

HOUGHTON, MICHIGAN

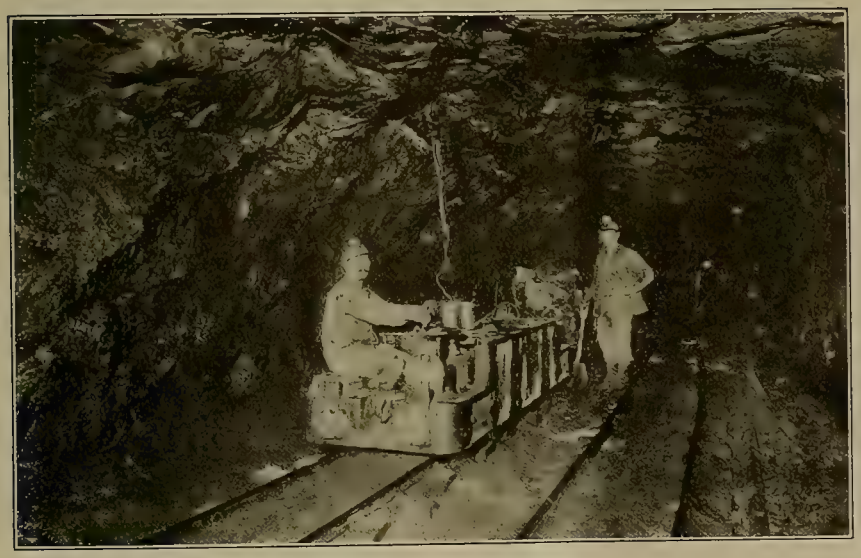
Calumet & Hecla Policy.—Copper Production.

The Calumet & Hecla and its ten subsidiaries, including Osceola Consolidated, La Salle, Isle Royale, Ahmeek, Allouez, Centennial, Superior, White Pine, Lake Superior Smelting, and the Lake M., S. & R. Co., comprising all of the mining, stamping, milling, and allied industries under the direction of first vice-president James MacNaughton, have announced a

continuation of the 10% bonus on the monthly pay and an additional bonus of 50c. per day for every man in their employ. This big pay has been in operation since last June and makes wages here higher than ever before. There is no doubt whatever that the Calumet & Hecla interests would have given the workingmen a further increase in pay if they had any expectation that the Government would permit a raise in the price of copper above the 23½c. now in vogue, arbitrarily fixed as stable for the metal used by the Government in munitions and for the Allies in their munitions. There was some hope that the price would be fixed at 25c. per pound as a number of the mines are operating at a close margin. As it is the continuation of present wages means the largest payrolls in the history of this district and is all the more satisfactory because the dividends to shareholders have been cut all the way from 50 to 300%, and in some of the mines they have been shut off altogether. The Calumet & Hecla announcement counts for more than one-half of the mining corporation employees of this district, 12,000 men in all. The other mining companies will follow the lead of the old Calumet, so that compensation to employees in the industry upon which this district depends will be as high for the coming six months as ever before and the production of copper for war purposes will be pushed as never before. It is a remarkable thing that every campaign for Liberty bonds, for Y. M. C. A. contributions, for Knights of Columbus work, and for Red Cross membership has met with enthusiastic approval and endorsement on the part of the miners of this district. There are no less than 30 different nationalities mixed in the cosmopolitan make-up of the Michigan copper district. Included are many technical alien enemies, Hungarians, Austrians, Croations, Germans, although only a comparatively small number of the last. They are employed in the mines. Their lodges have passed resolutions of loyalty to the United States, and nobody questions their loyalty. They are all members of the Red Cross and liberal contributors.



HARDINGE MILLS FOR RE-GRINDING MILL-PULP



ELECTRIC HAULAGE UNDERGROUND

There is reasonable expectation of an increase in output for December for the Hancock Consolidated, owing to the installation of the storage-battery locomotive. More trammers are needed.——Electric locomotives are used at the Calumet & Hecla and subsidiaries as soon as they arrive; they are being operated on the longest underground hauls. Allouez is using five with satisfactory results. On the Osceola vein at No. 15 two are in use; 25 in all will be employed; Isle Royale is using three.——Superior already can see the end in sight. This is one of the smaller Calumet & Hecla subsidiaries, yet it has an interesting history in view of the fact that the company was the first one taken over for management purposes, when the policy of expansion was undertaken by the Calumet interests. At the present rate of output, 450 or 500 tons per month, the Superior has less than a year and a half in sight.——The Franklin continues to handle 1000 tons daily and is better than breaking even at the Government price for the output. Practically all of this ore has a long tram haul, either by electric rope or compressed-air power.

Production of copper from the Michigan district will be 230,000,000 lb. for 1917. Exact figures will not be available for 60 days as smelters usually are from two to four weeks behind mills and mines in output. This estimate is based upon actual figures for the first eleven months of the year and estimates on December output. This figure is conservative and is just 5,000,000 lb. below the output for 1916. It is a remarkable record of efficiency, despite high costs, shortage of labor, and

inability to secure deliveries on necessities for mining, milling, and smelting operations.——No other copper-producing district in the world will come as near to normal as the Lake Superior district in 1917. This fact is a tribute to the highest class of copper-mining employees as well as the good management.——Calumet & Hecla alone will produce normal, 77,000,000 lb., compared with 76,762,240 lb. in 1916 and 71,030,518 lb. in 1915. Of the group of mines operated under the management of Mr. MacNaughton, as vice-president, the greatest increases are shown in Ahmeek and Isle Royale. Ahmeek's showing for this year is 28,600,000 lb., compared with a little better than 21,000,000 lb. in 1916 and 21,800,000 lb. in 1915. Isle Royale produced, in 1915, 9,342,000 lb., in 1916, 12,412,000, and this year 1917 the output will crowd 13,600,000.——Allouez will not produce up to the normal of 10,000,000 lb., Centennial likewise shows a falling off, and White Pine will be below 1916, but by only a small amount. Osceola Consolidated shows the greatest slump in output. It will show 16,300,000 lb., 3,000,000 short of normal in recent years. La Salle, while a small producer, shows a remarkable percentage of increase, rising close to 2,000,000 lb. this year. Superior clumps off nearly a million.——The total for the Calumet & Hecla interests for the year will be less than 3,000,000 lb. short of 1916. The Mohawk mine, one of the Stanton properties, will show 12,500,000 lb. Quincy production will exceed 21,000,000 lb., while last year this mine produced 21,065,612 lb. Wolverine figures for 1917 are 5,200,000 lb. Copper Range three mines show approximately 46,000,000 pounds.

While the production of copper from the three important south range producers, Champion, Trimountain, and Baltic, shows a falling off of 17% for the year 1917 compared with 1916, the respective totals being 46,000,000 and 54,747,498 lb., this is simply the result of intensive mining. Of this total the Copper Range company does not, of course, secure all, as the output of the largest producer, the Champion, is divided equally with the St. Mary's Mineral Land Co.——Quincy continues to turn out substantial mass copper with its regular run of ore. Regarding the larger masses that have been secured at the Quincy, there has been some doubt as to the ability of any smelter to handle an eight-ton chunk of solid copper. The Ahmeek mine frequently gets out masses that run 10 tons and only last week secured one that ran 11½ tons. This immense slab was cut from the solid sheet that has been one of the big Ahmeek assets for a long period. There was no difficulty in handling it in the smelter. The top is taken off the furnace and the copper oozed into the furnace much as a large piece of ice might be pushed into a water boiler. Cutting these solid slabs from the mine is a difficult job and requires men specially trained for the work. They use compressed-air machines that punch holes in a line a couple of inches apart across the solid copper slab; then the holes are packed tight with 100% blasting-powder and the powder is smeared across the whole row of holes. When it is fired it makes a rough break across the solid mass.——The output at Winona is running better than 500 tons per day with a steady improvement in the grade of ore extracted under the present system. The tributers are paying the employees a premium over their regular wages for the higher-grade ore, the premium increasing directly with the proportion of copper.—— While Calumet & Hecla, the old mine, shows slightly better output for 1917 than for 1916, it must be remembered that this figure includes the output from Tamarack, formerly listed as a separate property.——Within three weeks the additional turbine for the power-plant at Lake Linden will be in use and furnishing additional power to the main mine and subsidiaries as needed. More motors for hauling tram-cars underground are going into operation this month, some on the Osceola lode at the Calumet & Hecla, some at Isle Royale, and some at Ahmeek.——The Champion continues to be the marvel of richness in copper output of any property in the Lake Superior district. Tonnage is maintained at normal and, while the proportion of copper is not going to show as high for 1917 as it did for 1916, the decline is small indeed. Some of the richest shoots of copper in this mine are just beginning to be opened.

COBALT, ONTARIO

Coniagas.—McKinley-Darragh.—Peterson Lake.—Castle.

The silver-mining companies of Cobalt are beginning the new year under exceedingly favorable conditions, due to the high price of their product. Labor is comparatively plentiful and, although the cost of material and labor is considerably higher than a year ago, the high price of silver more than offsets the increase.——The annual report of the Coniagas company, which is expected to be issued within the next few weeks, will show a total of upward of 1,300,000 oz. of silver mined at a cost of a fraction over 21c. per ounce. The price of silver during the year 1917 averaged over 81c; it therefore follows that the net profit was 60c. per ounce.——Excellent results are being found at the 400-ft. level of the McKinley-Darragh. The method of re-grinding the tailing from the bed of Cobalt lake for treatment by flotation has been found unsatisfactory, and the new oil-flotation plant is undergoing some changes. The rod-mills are being replaced by ball-mills and with a return to warm weather the plant will be in shape to operate at full capacity.——The Peterson Lake company is considering the advisability of erecting a mill to treat the old tailing-dump of the Seneca Superior.——During December approximately 102 ft. of underground work was done at the Adanac. The zone to the north, the exploration of which geologists have recommended, will be reached within the next month, and the operation is commanding considerable attention.——The Mining Corporation and the Nipissing Mines Co. are maintaining a heavy yield and appear to be entering into a prosperous year.——The Castle Mining Co., owning property in the Gowganda silver area, has confirmed an arrangement with the Tretheway mine of Cobalt whereby the latter options the stock of the Castle property. The Castle company has 500,000 shares in the treasury, on which the Tretheway company has an option at 20c. per share, and some 265,000 shares outstanding are to be optioned at the same price. The property is adjacent to the rich Miller Lake O'Brien mine and is looked upon as a prospect of considerable merit.

At no time in the history of Porcupine were development operations being conducted on a more aggressive scale than at present. Work which during the boom days would have caused excitement now passes almost unnoticed. Notable among recent discoveries are those in the 800-ft. level at the Dome, in the 1000-ft. level at the McIntyre-Porcupine, and in the 1400-ft. level on the Millerton claim at the Hollinger.—— The Schumacher company is gradually strengthening its position. The plan of the management to carry the main shaft from its present depth of 600 ft. to the 1000-ft. level will shortly be done. The new mill is in full operation and giving good satisfaction.——The Porcupine Crown is developing considerable ore at the 1000-ft. level.

The British American Nickel Corporation has under construction near Sudbury a new electrically-operated smelting refinery, which will have a capacity of 2500 tons of ore daily and a nickel production of 20,000,000 lb. per annum. The smelter will produce a matte carrying 80% copper and nickel combined, which will receive final treatment in the refinery.—— The International Nickel Co. is constructing a new refinery at Port Colborne at a cost of $4,000,000, which will be in operation in a few months. The initial capacity will be 15,000,000 lb. of nickel per annum, but it can be expanded in a few years to produce 60,000,000 lb. The new plant, according to the company, will be able to supply the needs of the whole British Empire.



ALASKA

(Special Correspondence.)—As a result of energetic prospecting by representatives of the Alaska Treadwell Co. during the summer, a molybdenite property situated about 80 miles from Wrangel has been bonded at Shakan. It is said to be extensive, although but little development has been done. Molybdenite is disseminated uniformly through the ore which also carries but a small amount of copper. Work of equipping and developing has already begun under Peter Johnson, formerly foreman of the Treadwell mines. A concentrating plant will be erected in the spring.

Treadwell, December 30.

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—More than $281,000 was distributed among the employees of the Copper Queen branch of the Phelps-Dodge Corporation, the Calumet & Arizona Mining Co., and the Shattuck-Arizona Copper Co. on January 7, in Bisbee and Douglas, this amount coming as bonuses in extra checks along with the regular pay checks for the last half of December. The miners employed by these companies in the Warren district received these checks, according to their term of employment, the amounts ranging from $100 to $30. All white employees on the surface and underground who had been continuously in the employment of the companies for one year or more received $100, while those who had been in the service for six months to one year received $50. The Mexicans employed on the surface continuously for one year or more received $60, while those who had been in the service from six months to one year received $30. The amount distributed to the underground and surface employees of the three companies in the Warren district totalled $186,250, divided among the three companies as follows: Copper Queen, $110,000; Calumet & Arizona, $65,000; Shattuck-Arizona, $11,250. At the Copper Queen and Calumet & Arizona smelters in the Douglas the same bonuses in the form of extra checks were paid the smeltermen, the same amounts being given as were received in the Warren district. The amount paid in Douglas totalled $95,620, as follows: Copper Queen smelter, $60,000, and Calumet & Arizona smelter, $35,620. The wages paid at the mines and smelters are on a sliding scale, governed by the price of copper. With copper at 23½c. the men at the mine receive $5.35 per shift of eight hours, the time beginning at the collar of the mine-shaft. At the smelter the following wages are paid: furnace-men, $5.35; machinists, $5.60; converter-men, $5.35 to $5.60; crane-men, $5.60; carpenters, $5.60; common labor, $2.30 to $2.60. Announcement has been made that the companies are working out a permanent time-service bonus plan whereby continuous service will receive special consideration.

Douglas, January 7.

MARICOPA COUNTY

(Special Correspondence.)—Development on Empress Copper mine 15 miles east of Wickenburg has reached a depth of 400 ft. The vein is six feet wide and averages $15 gold and 13½% copper. The mine is equipped with a 25-hp. hoist and a Sullivan-Foos 70-hp. engine; an electric pump to hoist 40 gal. of water per minute is being placed on the 400-ft. level. J. P. Hutchinson of Phoenix is president and superintendent.

The management of the Carmelita Mining & Milling Co., with property in the Yuma range, is installing a gasoline hoist, Ritz air-compressor, hammer-drills, ball-pulverizer, three concentrating tables, and flotation process, all of which have been purchased in Los Angeles through the agency of the Kennard-Bierce Engineering Co. In the early days many thousand dollars were obtained by the arastra process. There are 17 claims in the group with more or less development upon each. J. A. Marx is superintendent.

Phoenix, January 10.

MOHAVE COUNTY

(Special Correspondence.)—The newly constructed concentration mill at the Red Cloud mine, 40 miles north of Yuma, is proving satisfactory. At 500 ft. the vein is 14 ft. wide and from this depth a cross-cut has been driven and a streak of high-grade ore found. The mill is of 300 tons capacity and is equipped with Hendy crusher, Eggleston ball-mill, and three Stebbins dry-concentrating tables. A product of 15 tons into one is produced. Cris Engle is superintendent.

Yuma, January 10.

A. G. Keating, consulting engineer to the Gold Mining Co., expects to commence shipping 100 tons of ore daily by March 1. It may require two weeks time to fill up the ore-bins of the old Gold Road mill, as they have from 1200 to 1500 tons capacity. By March 15 the mill should be treating 100 tons daily and bullion should be turned out 30 days later.——With December partly estimated, it can now be stated that the Oatman district produced only a little short of $2,500,000 in gold during 1917. This is more than three times the production of 1916, and it exceeds by over $500,000 the greatest amount ever mined in the district before. The year 1912 showed the highest previous production, according to Government statistics, the figures being 1,899,131.——The west drift from the 550-ft. level of the Gold Road Bonanza shaft has been driven 40 ft. from the shaft in commercial ore.——The close of the first year's operation of the United Eastern sees production maintained at the usual rate. The work of cross-cutting to the vein at the lower new level, 1090 ft. below the collar of the shaft, is about to begin; from 30 to 60 days may be consumed in opening the vein at this level.——Exploration of the Tom Reed Gray Eagle vein by means of a cross-cut from the 535-ft. level of the Aztec vein is now under way, but several weeks will be spent in driving this cross-cut, as the two veins are about 400 ft. apart.——At a depth of 350 ft. a station has been cut by the Record Lode Mining Co. and driving along the vein is now in progress.——The United Oatman adit has been driven nearly 800 ft. on the Ophir vein. A cross-cut to the west is also being driven.

Oatman, January 12.

PIMA COUNTY

(Special Correspondence.)—C. P. Reiniger has taken an option on the Orient and Copper Mountain group of claims from the Mile Wide Copper Co. The Orient group is on the northern side of the Tucson mountains and from the work that has been done at present the property has an encouraging prospect.——It is expected that development work on the Wake-

field-Bellmer claims in the San Xavier-Twin Buttes district will commence in a few days. A compressor has been erected and the head-frame is almost completed.

Tucson, January 5.

YAVAPAI COUNTY

(Special Correspondence.)—Work at the Jerome-Portland has been stopped. The men have been paid off, the pumps pulled out of the 500-ft. shaft, and some of the equipment sold. J. F. Miller & Co. of Jerome has placed an attachment totaling $4100 on the real estate holdings of the Jerome-Portland.——It is reported that some ore has been discovered in the 1200-ft. level of the Blue Bell mine of the Consolidated Arizona Smelting Co., which is running higher in gold and copper than the ore on the 1600-ft. level. Recent development 2000 ft. south of the main shaft of the Blue Bell has opened a 24-ft. orebody at a depth of 75 ft. The company plans running a drift on the 800-ft. level southward to open the new strike at depth.——The Jerome Del Monte has suspended operations for the period of the War.——Shipments from the Jerome Verde have been suspended because it failed to renew the contract with the United Verde Extension to hoist 25 tons of its ore per day.

Prescott, January 7.

CALIFORNIA

ELDORADO COUNTY

The new Chili type of ball-mill is in operation at the Cincinnati gold quartz mine, situated 11 miles north-west of Placerville. On January 9 Jesse W. Taylor, of Fort Worth, Texas, accompanied by N. H. Burger, manager of the Cincinnati mine, and Burr Evans, mining engineer, made an examination of the mine and mill. The mine is opened and worked by a 300-ft. adit on the vein. At present ore is being stoped 50 ft. above the face of the adit from a 16-ft. pay-shoot of friable porphyritic material intermixed with particles and pieces of quartz, some of which contain high-grade gold-bearing arsenical pyrite. The entire cost of mining and milling the ore is less than one dollar per ton. The mill is operated by a 7-hp. gasoline engine. At present about 1½ tons per hour is put through the mill, but it is expected that this will be increased to two tons or better. Mr. Taylor is here to consult with Burr Evans with the view to interesting himself and Texas associates in the mines of this county.

KERN COUNTY

The miners of this county have formed an association to be known as the Caliente Creek Mining Association, which will meet at least once each month with the view of exchanging ideas and generally promoting the welfare of the mineral industry of the district. C. J. Stoneham, superintendent of the Copper-Jap mines, was elected chairman and Joe J. Carroll secretary.

NEVADA COUNTY

(Special Correspondence.)—An 8-in. shoot of gold quartz, assaying $400 to $500 per ton, has been struck on the 900-ft. level of the Norambagua mine. Prospecting has been in progress over a year at this depth, and arrangements are being made to develop the new shoot vigorously, in the belief that it is a branch of the main orebody. C. T. Green is superintendent.——Good ore has been found in the western end of the Golden Centre mine. A short run of the mill recently yielded $35,000, according to reports by workmen. Several months ago the directors authorized sinking of the main 1000-ft. shaft to a depth of 2000 ft. and development of new ground is being pushed as rapidly as the water is cleared out. The mill is running steadily and the working-force was increased.——The California mine, near Rough & Ready, is reported to be developing well. It is owned by King C. Gillett and associates of Los Angeles and has been equipped with an excellent plant.—The new vein uncovered in the Sultana continues to develop well, and the company is arranging for more extensive operations. The strike was made on the 1000-ft. level, and, according to reports, about the time the company was considering suspension of work.——Most of the equipment formerly operated at the North Star shaft of the North Star mine has been dismantled and numerous sections moved to the Central shaft. Use of the old shaft has been practically discontinued, but it is kept in repair for safety and ventilating purposes. The Central shaft is more than 6500 ft. deep and splendidly equipped. Development in the lower levels has been satisfactory.——The 40-stamp mill at the Brunswick Consolidated is running steadily; good ore is reported at several points. Much new ground has been added to the productive area in the past year.

Grass Valley, January 16.

SHASTA COUNTY

(Special Correspondence.)—The Mammoth Copper Co. has given up its bond on the Delta Consolidated gold mine, six miles west of Delta on Dog creek. The Delta Consolidated Co. has sold the steel rails on the 6-mile railroad from the mine to Delta to a lumbering company. The 300 tons of steel was sold for $60 per ton, or more than it cost when the railroad was built in 1908.——The Central mine, at Old Diggings, which has been idle for years, is being opened up by A. A. Anthony, who has become the sole owner. He has given a lease to W. J. Thompson and James W. Holbrook, who are opening a good body of gold quartz.——A new body of ore has been uncovered in the New Year's mine at the Balaklala camp. The ore was found by a diamond-drill, and proved by a raise of 100 ft. from the old workings. The New Year's is a claim in the heart of Balaklala ground, owned by the Mountain Copper Co.——On December 24, fire destroyed a four-story bunkhouse and the boarding-house at the Balaklala mine. A full stock of provisions had been laid in for the winter. The loss was $40,000. The management believes that the fire was of I. W. W. origin. Temporary quarters were soon provided. The mine was shut-down for only two days.

Redding, January 5.

The Mountain Copper Co. is doubling the capacity of its oil-flotation plant at Minnesota station, midway between the Iron Mountain mine and Keswick. It is not building a cyanide plant, as currently reported. The first flotation-plant was built three and a half years ago, and was doubled in capacity two years later. The enlarged plant will have a capacity of 1000 tons per day. Grading for the site is under way. The company is hampered for the want of material, as it can only get lumber and other building products at the pleasure of the Government. Work will be rushed as rapidly as war conditions will permit. The Mountain Copper Co. was the first mining corporation in Shasta county to use oil-flotation.

TULARE COUNTY

(Special Correspondence.)—During 1917, 1970 cars of magnesite, worth approximately $2,400,000, was shipped from the Porterville district. As each car averages about 45 tons this makes a total of nearly 90,000 tons. Of this amount about 50,000 tons was of the calcined ore, worth approximately $2,000,000. The remaining tonnage was shipped in the raw state and is valued at about $400,000. Recently Federal authorities made a special request for data on the magnesite output of this district last year and the prospects for the amount available in the future. It is probable these data are being sought in line with other war preparations of the Government, as the output of the steel plants is in a large measure dependent on the output of magnesite. Owing to its highly refractory qualities magnesite is used extensively for linings of furnaces where a high temperature is maintained.

Porterville, January 9.

TRINITY COUNTY

The all-steel dredge of the Pacific Gold Dredging Co. has been running a month in its new position at the mouth of Coffee creek, four miles down stream from the mouth of Morrison gulch, where it was set up originally. The dredge has run smoothly from the day it was started. It will be remembered that the presence of large boulders was the cause of dismantling the dredge at Morrison gulch. No trouble from this cause has been found at Copper creek. Jack Harvey is the new superintendent of the dredge.

COLORADO

PITKIN COUNTY

(Special Correspondence.)—On January 8 the stockholders of the Hope M. M. & L. Co. held its annual meeting. A canvass of the stock at the meeting showed that 67,715 shares were represented in person or by proxy. The following officers were unanimously re-elected: Charles O'Kane, president; James W. Hetherly, vice-president; Harold W. Clarke, secretary; John B. Stitzer, treasurer; and Charles O'Kane, Henry Turley, Albert Peterson, James W. Hetherly, and John B. Stitzer, directors. In his report to the meeting, Mr. O'Kane stated that during the past year the main adit had been advanced 1047 ft. at a total cost of $15,275, making the average cost per foot $14.58. The advance made in the breast varied during the year, some months showing better results than others. Following the advice of Messrs. Tower and Foote, who recently made an examination of the Hope properties, the course of the Annie cross-cut has been turned to due east. In making this turn, the drift cut 100 ft. of porphyry and a number of low-grade ore deposits, assaying as high as 22 oz. silver, 14% lead, 2% copper, and 22% zinc. The deposits, however, would not average as high and could not be handled profitably, but their presence is considered to be a favorable indication of richer bodies ahead. One large shoot was 75 ft. thick. The question of increasing the capital stock from 100,000 to 150,000 shares came up before the meeting and was passed without a dissenting vote. The additional capital is required to complete successfully the work now under way. The prospects of the enterprise are regarded as bright, and it is believed that large bodies of shipping ore will be found during the year.

Aspen, January 13.

TELLER COUNTY

(Special Correspondence.)—The December production from mines of the United Gold Mines Co. was 66 cars, containing 2500 tons of an average value of $21 per ton, and a gross bullion value of $52,500. The production from the several properties was as follows: Trail mine, Bull hill, Anderson and Benkelman lease, 43 cars; J. L. Wilson lease, 12 cars; W. P. H. mine, Ironclad hill, shipped by the W. P. H. Leasing Co. of Cripple Creek, 7 cars; Bonanza, Battle mountain, operated under lease by the Granite Gold Mining Co., 2 cars. This ore assayed close to 3 oz. gold per ton. Wild Horse mine, Bull hill, 2 cars mined and shipped on company account. The Wild Horse company on December 20 paid a 1 cent dividend amounting to $40,090 from accrued royalties paid into the treasury by lessees during the past year.——The output from properties of the Elkton Consolidated Mining & Milling Co., on Raven hill, for December amounted to 24 cars, or 850 tons, including dump shipments and the average value held close to one ounce gold, dump ore running as high as $17.50 per ton. The company resumed operations during the month and shipped two cars of mill ore. George E. Collins of Denver, manager of the Mary Murphy mine, operating the Tornado mine of the Elkton company, shipped 4 cars of 1-oz. grade.——The Cripple Creek Deep Leasing Co. and its sub-lessee F. T. Caley, operating the Jerry Johnson mine on Ironclad hill under lease from the Jerry Johnson Mining Co., produced 455 tons of mill ore, averaging $21 per ton, during December. Two cars from the Caley lease, taken between 600 and 700 ft., brought $57 and $60 per ton, respectively.——Edwin Gaylord, of Cripple Creek, lessee on the Forest Queen mine on Ironclad hill, shipped 325 tons to the mill of the Golden Cycle Mining & Reduction Co. during December. The lessee is mining ore from a new shoot recently entered at the 600-ft. level east.——The Ocean Wave Mining Co. has pay-ore in the 400-ft. level of the new Hurst shaft at the Ocean Wave and will commence to ship shortly. ——An ore-house of 200 tons capacity with ore-washing tanks, and electrically lighted and heated, is under construction at the Lewellyn shaft on the Longfellow on the eastern slope of Bull hill. The property is owned by the Stratton estate and is leased to the Excelsior Mining, Milling & Electric Co.—— The Vindicator Consolidated Gold Mining Co. shipped 200 tons of concentrate from its plant near the Golden Cycle mine last week for treatment at the Golden Cycle M. & R. Co.——The following dividends will be paid on January 10: Cresson Consolidated Gold Mining & Milling Co., 10c. per share, $122,000; Golden Cycle Mining & Reduction Co., 3c., $45,000; Granite Gold Mining Co., 2c., $16,500.——A stockholders meeting of the Holliston Mines Co. has been called to consider the sale of the company's holdings in this district.——Stockholders of the Amazon Mining Co. will meet shortly to consider a proposition to dissolve. The holdings of this company, excepting small fractional claims, were sold some years ago and dividends paid from sale proceeds.

Cripple Creek, January 8.

IDAHO

SHOSHONE COUNTY

The third dividend of 5c. per share has been declared by the Hecla Mining Co. Until November last the company was paying 15c. per share monthly. Lower prices for metals and the heavy Federal tax have caused the reduction in dividend rate.——For the first three weeks of operation $12,000 per week is the reported amount cleaned up by the Yukon Gold Mining Co., which recently began placer operations on Pritchard creek. The company is working the stream along which gold deposits were first discovered 35 years ago. Some large nuggets have been found. The company is a Guggenheim corporation which has secured the placer rights to 12 miles along the creek.——Net returns of $225,921 were made by the Rex Consolidated Mining Co., at Wallace, from ore taken out during the first ten months of 1917, according to report of Raymond Guyer, manager. The mine was idle in November and December.

No dividend has been declared. The records, when completed, will probably show that the profits have been expended in development work which has been expensive because of higher cost of supplies and labor. Resumption of work is expected at an early date.

MISSOURI

JASPER COUNTY

A concentrating plant is slowly being built by the Pleasant Valley Mining Co. on its lease about three miles south-west of Carthage. A good part of the equipment already is in place and more is being added, with the idea of having the plant complete by spring. The Pleasant Valley mine has been a good producer during the past year, operated merely as a hand-jig property. There has been a battery of nine of these hand-jigs, however, and a carload of ore has been made on the average and when things have been running well about every ten days. Operations are conducted at a depth of 100 ft., and the ground is well opened, there being two shafts in use. The concentrate is particularly satisfactory, being lead free, less than 1% in iron, and usually showing about 62% metallic zinc. The equipment at the plant, besides the hand-jigs, already includes a 90-hp. gas engine, a set of 30-in. rolls, a 14-in. crusher, and rougher and cleaner jigs are now being

built. The company is made up of J. H. Millard, H. H. Hoffman, and W. M. Graves of Carthage, and W. S. Pitt of Minnesota. Mr. Graves is superintendent. The company is operating this mine on a 20-acre lease of the Freer land, but it has in addition leases on the Douglas and St. Louis land, for a total of 100 acres.

LAWRENCE COUNTY

Recent drilling operations on the Grier land, west of Aurora, have been decidedly successful and it appears that a new richly-mineralized tract is about to be opened there. To date eight holes have been put down, five of which have showed excellent mineral. The last hole went into ore at 135 ft., and was still in it at 155 ft., indicating a 20-ft. face. The other holes showed ore at approximately the same level and for the same depth. The development work is in charge of J. H. Grier, owner of the land. After the drill prospect work is completed he intends to lease the property or develop it himself.

NEVADA

ESMERALDA COUNTY

(Special Correspondence.)—The Kewanas company is preparing for more comprehensive work in the northern and southern ends of the property. In the latter area connections have been made with the shaft of the Jumbo Junior, and a series of raises will be driven to prospect the main orebody. This has yielded some rich ore in the Jumbo Junior and ore of shipping and milling grade in Kewanas territory. In the northern section the more important work is proceeding 800 ft. north of the station.——Occasional shipments are being made from the Great Bend to the sampler of the Western Ore Purchasing Co. The product comes from the intermediate drift below the 160-ft. level, where two feet of $100 ore accompanies the lower-grade material. From the 300-ft. level a drift is nearing the old Lockhart lease shaft, where milling ore was exposed when the lease ceased work. It is the plan of the management to eventually improve the small mill and operate the plant on the medium-grade ore in sight.——Free-milling ore assaying $25 to $90 per ton is being broken in an intermediate drift above the 100-ft. level of the Blue Bull. The vein occurs in the Pig claim and is narrow. A winze is down 125 ft. on this vein and driving from the 250-ft. level will start shortly for the purpose of developing ore at this depth.——Conditions at the Spearhead are improving. New work on the 250-ft. level has opened milling ore near the Wheeler shaft, and on the 910-ft. level north and south drifts are exposing milling-grade ore. From the east cross-cut on the 320-ft. level of the Cracker Jack drifts are prospecting two promising veins, showing scattered bunches of gold and silver-bearing ore.

Goldfield, January 14.

During November the Goldfield Consolidated produced 16,350 tons of ore at a profit of $8380, and 14,459 tons of mill-tailing was treated at a profit of $1981. Development to the amount of 858 ft. was performed at a cost of $7.74 per foot.

LINCOLN COUNTY

(Special Correspondence.)—The Virginia-Louise Co. has placed orders for a large hoisting-engine and other machinery, and plans to start extensive operations in February. The management reports that considerable ore of profitable grade is exposed. The apex suit of the Prince Consolidated against the Virginia-Louise will be called in the Federal Court at Carson City shortly; both parties have retained eminent counsel. The Virginia-Louise recently brought suit for damages against the Prince Consolidated, alleging defendants had extracted ore unlawfully from its holdings. A decision by Judge Averill of Tonopah is expected soon.——The Raymond-Ely West Mining Co. is contemplating early resumption of activities. The property adjoins the Amalgamated-Pioche and Greenwood mines, and the Greenwood Leasing Co. is endeavoring to secure a long-term lease. It is also reported that the company may operate extensively on its own account. Simon E. Bamberger, governor of Utah, E. A. Vail, M. B. Johnson, W. E. Harrison, and other Salt Lake capitalists are interested.——Much new work is proceeding at the Prince Consolidated, Amalgamated-Pioche, and other properties in this field. Late developments in the Prince Consolidated have been particularly encouraging, according to reports from the mine. This property has paid $500,000 in dividends to date.

Pioche, January 13.

NYE COUNTY

(Special Correspondence.)—Milling and shipping ore have been developed on the 200 and 300-ft. levels at the Mayflower mine, and 1400 ft. north-west of the shaft a promising vein has been uncovered near the surface and opened to a depth of 35 ft. For the entire distance the vein consists of excellent milling ore, with portions carrying a high gold content. Arrangements have been made for extensive work on the first, second, third, and fourth levels, and from the third a drift will be extended to connect with the Starlight shaft. The mill is to be overhauled and improved, preparatory to steady operation. The management reports a large tonnage of profitable ore exposed. The property is owned by the Consolidated Mayflower Mines Co., of which W. J. Tobin is president and general manager.——The Sunset Mining & Development Co. is devoting particular attention to the Denver mine, where good ore has been opened on the 450 and 500-ft. levels. Abundant water for the mill has been secured and the management expects to operate the improved plant steadily this year. The holdings include the Denver, Tramps Consolidated, and Sunset groups.——The Pioneer Consolidated Co. is completing negotiations for a steady supply of power for the mill. A large tonnage of milling ore is in sight, but for several months the mill has been idle because of inability to secure economical electric power. Underground work has proceeded steadily and an extensive reserve of profitable ore is available for mining.——Leasing is active at the Montgomery-Shoshone, Indiana, and other properties. Arrangements have been made for early resumption of work on the New Year, Gold Bar, and several others. Many of the companies have been recently reorganized on an assessable basis.

Pioneer, January 5.

WHITE PINE COUNTY

(Special Correspondence.)—The Nevada Consolidated Copper Co. is running smoothly and turning out its usual tonnage of ore. Owing to the continued shortage of coal, fuel-oil is being used in the reverberatories and converters, though at a much greater daily cost than coal. The new railroad cut-off across Steptoe creek, which materially reduces the grade to the smelter, is completed. On account of the reduced grade the ore trains are hauling thirty 60-ton cars with the same locomotive and crew that formerly hauled 21 cars of 55 tons capacity.——The Consolidated Copper Mines shut-down its mill on January 1 and laid off about 200 men. It treated an average of 800 tons per day during the last month. The mill while metallurgically efficient was so poorly constructed that a thorough overhauling has become necessary, and, as there is a shortage of ore, the present time is convenient for making the repairs. But the main cause of shut-down is for want of ore to keep the mill supplied. For the past two months the Nevada Con. has mined and delivered at its mill from the Giroux Ora claim some ore continuously. It is planned to develop the mine while the mill is closed, and thus ensure a supply of ore when the repairs have been completed.——The county road has been changed from Keystone to the Coppermines property, which allows the company to put in a retaining dam to impound the tailing that has been running down by Robinson creek.——The Ward mine is shipping 25 tons

daily.——About 30 tons of 40 to 50% manganese ore is being shipped daily from a mine about seven miles south-east of Ely. There has been a dispute over title of part of the ground and an injunction against shipping was granted; but this was recently settled, by allowing one of the parties to mine and ship and deposit in the hands of the Court $12 per ton until such a time as the title of the ground in dispute shall be settled by the courts.——The Muncy Creek property and the Lucky Deposit at Aurum, are continuing to ship copper ore. The county commissioners allowed the expenditure of $100 to gravel and grade the road for trucks to a new spur put in on the Nevada Northern, about four miles south of Cherry Creek station, thus shortening the haul by about 30 miles.——Most of the lessees and outside work is closed for the winter.

Ely, January 3.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—The production for the district for 1917 was 12,590 oz. gold and 732,581 oz. silver, or at present prices $903,000.——The principal operating companies were the Socorro Mining & Milling Co., the Mogollon Mines Co., and the Oaks Co.——On October 26 fire destroyed the mine plant and upper portion of the Socorro mill. These are being replaced rapidly. A large part of the material is now on the ground and it is expected that the plant will be in operation early in the summer. Among the important developments of this company has been the cutting of a large body of good ore on the 1100-ft. level and new orebodies in the Johnson and Champion mines. The Mogollon Mines Co. completed its new 900-ft. shaft, has the drifts well started on lower development, and has largely increased the available ore-reserve during the year. Its 150-ton mill has run steadily to capacity.——The Oaks Co. has increased operations during the year. In March it took over the Maud S. mine, found ore within 30 days, and has been shipping daily to the mill since. In June the Deep Down mine was acquired, the Central shaft re-timbered, and a headframe and hoisting-plant erected. Ore has been opened west of this shaft, which is being developed and shipped to the mill. Development and production have been continued at the Eberle and Clifton mines, the other two properties of the Central group, which are to be operated through the shaft on the Deep Down mine. Work was started on the Pacific mine in December and arrangements are being made to continue regular production.——The Deadwood shaft is being unwatered, material is being delivered, and this property will no doubt be in operation in the near future.——The main adit on the Iron Bar group is being driven to cut the ore found in the upper workings.——The year's operation at the camp has been favorable. While the fire at the Socorro mill reduced the production of the district to a marked degree the developed new ore in the deepest workings and the new properties opened point to a much increased production for 1918.

Mogollon, January 9.

OREGON

JACKSON COUNTY

(Special Correspondence.)—Since the winter rains have set in, the copper mines in southern Oregon, which have long wagon-hauls, are reducing their shipments of ore and are developing for record shipments next season. The Blue Ledge has 60 men employed and is shipping 1000 tons per month, while the Queen of Bronze has 40 men employed and is shipping 1200 tons per month, and the Waldo has quit shipping and has 10 men employed developing.——O. C. Runnels of Seattle, representing people of that city, has purchased the Utah group of quicksilver mines, 12 miles north of Gold Hill, as well as the Samuel Bertleson group of adjoining claims, and intends to combine these properties. These mines are contiguous to the Chisholm group of mercury mines, which is equipped with furnaces. Machinery is being ordered to equip these new mines and representatives of several machinery companies are on the ground to arrange the final details.——Tony Ross and Lawrence Witsette of Gold Hill, who have a lease on the Reynolds copper mine six miles west of Waldo, are making considerable progress in development work. Recent assays show that the copper ore near the surface runs 10 oz. in silver per ton and some gold. This property is eight miles west of the Queen of Bronze copper mines and within half a mile of the Grants Pass-Crescent City highway. Five veins, from 5 to 20 ft. wide, run through the property at an elevation og 2600 feet.

Gold Hill, December 31.

(Special Correspondence.)—O. C. Runnalls of Seattle, who recently acquired the Utah and Bertleson groups of cinnabar mines, 12 miles north of Gold Hill, for Seattle investors, will incorporate a company with a capital of $600,000 and equip the properties with a mercury-reduction plant of 100 to 200 tons capacity. A power-line will be erected from the C-O Power Co.'s line in the Beagle district, five miles from the mine, and electric power will be used in operating. Samuel Bertleson of Beagle will be the local manager temporarily.

Gold Hill, January 5.

TEXAS

BREWSTER COUNTY

(Special Correspondence.)—The Marfa & Mariposa Mining Co. has lately sold all its interests, mine, two 12-ton Scott furnaces, and about 2000 acres of cinnibar-bearing land. This



PART OF TEXAS

mine was discovered by Thomas Golby and G. H. Normand in 1897 and began to produce quicksilver in 1899. For several years it turned out about 400 flasks per month and paid over $500,000 in dividends. The rich ore was found between the massive lime and an impervious clay, in one instance a 'kidney' was taken out just below the surface of the ground weighing 45 tons; many smaller 'kidneys' were found. In 1909 these rich surface deposits began to be more difficult to find and as no work had been done on the low-grade fissure veins in the massive limestone, in which the cinnabar was found in banded calcite, it was found impossible to run at a profit at the low prices then prevailing, so the mine was closed. In 1916 it was leased to the late superintendent, A. Newell, was re-opened, and has been steadily producing ever since with a small force of men and only one furnace operating. The Chisos mine is producing 500 flasks of murcury per month. The Big Bend, the Texas Almaden, and other mines are also producing quicksilver and the prospect for a still larger output of mercury is encouraging.

Terlingua, January 7.

CANADA

BRITISH COLUMBIA

The Highland Valley Mining & Development Co. will erect a hoist and air-compressor, and the capacity of the mill will be increased to 100 tons per day. In November the mine produced 70,000 lb. of copper in the form of a concentrate running 22% copper. With the added improvements it is estimated that wide and assays from 4 to 5% of copper.——The orebody struck on the Noonday mine recently has been followed for 40 ft., according to a report from Kaslo. It has a width of eight feet throughout. More than a foot of it is of a shipping grade, the remainder being concentrating. The strike was made at a depth of several hundred feet, at a point near the line of the Noonday and the Consolidated Mining & Smelting properties. The drift is proceeding into the Noonday from the direction of the Consolidated.

MEXICO

(Special Correspondence.)—During the month of December there was shipped through the Douglas port of entry 317 cars of Mexican-mined ore and concentrate, having an estimated value of $2,785,000, as compared with 354 cars in November having an estimated value of $2,873,600. The number of cars, points of origin, and tonnages are as follows:

Origin point	Cars	Tons
Nacozari	255	10,207
La Estrella	18	731
El Tigre	14	497
Promontorio	11	404
El Rosario	5	180
Belen	3	131
San Pablo, Ultima Chanza, La Caridad, Esperanza, Cuicuila, Archipielago, Santa Rita, Las Chispas, San Francisco, La Fortuna, and La Reforma, one car each	11	277
Total	317	12,490

The shipments from Nacozari were composed mostly of copper-silver concentrates from the concentration plant of the Moctezuma Copper Co., which is situated at Nacozari. These concentrates were treated at the Copper Queen smelter at Douglas. The shipments from El Tigre were composed of concentrates from the concentration and oil-flotation plant of the Lucky Tiger Combination Co., the shipping point being the station of Esqueda, on the Nacozari railroad. These concentrates are treated at the El Paso smelter. The Promontorio mine is owned by the Phelps-Dodge Corporation, the ore carrying principally copper and silver. The mine is situated in the district of Moctezuma, about 100 miles south of Nacozari, and the ore is shipped to that point by wagon and mule-back transportation.

Nacozari, Sonora, January 7.

SPAIN

PROVINCE OF VIZCAYA

At a joint meeting of the shareholders of the Altos Hornos de Vizcaya and those of the Hulleras del Turón an agreement was reached for the purchase by the Altos Hornos of the coal mines in Asturias, now owned by the latter company. This purchase follows a lengthy examination of the Turón coal mines, and extensive tests of the coking quality of the coal. The price is said to be 20 million pesetas, or approximately $4,000,000, which is six times what the mines would have brought three years ago, but the great iron and steel operations of the Altos Hornos is relieved from uncertainty of supply and exorbitant costs of its needed fuel by taking over these Asturian coal properties, even at such a figure. The mines of Turón produced 240,000 tons of coal in 1916, and has developed at a faster rate than any other coal property in Spain.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

William W. Mein is here from New York.

Cooper Shapley, of Bishop, is in San Francisco.

W. L. Payne has arrived here from Moscow, Russia.

D'Arcy Weatherbe is expected here from Shanghai, China.

John J. Croston is Lieutenant in the 27th Regiment Engineers.

S. C. Bullock is Captain in the Royal Engineers, British Army.

J. Power Hutchins is due in San Francisco from Petrograd, Russia.

F. H. Hayes is Captain and Adjutant, First Arizona Infantry.

William Hutchinson is in the Canadian Forestry batallion, in France.

Scott Turner is in San Francisco, on his return from Peru to Toronto.

Harold Rickard is Lieutenant in the Royal Engineers, British Army.

Douglas Clark is with the Seoul Mining Co. at Tul Mi Chung, Korea.

George W. Coffey is Lieutenant in the Engineer Officers Reserve Corps.

J. W. Moule is now metallurgist at the Great Cobar smelter, New South Wales.

L. C. Parker, formerly at Butte, is now mining in Shasta county, California.

Dee W. Minier, First Lieutenant in the 112th Engineers, is now at Los Angeles.

John McCombie has been appointed manager for the Waihi Extended, New Zealand.

A. F. Duggleby is with the 27th Engineers, and is stationed at Camp Meade, Maryland.

W. H. Lanagan has been promoted to Major in the Engineer Officers Reserve Corps.

Edward Walser, of Butte, Montana, was in San Francisco this week on his way to Denver.

A. B. Rogers, of Denver, has assumed the management of the North Star mine at Yuma, Arizona.

E. V. Daveler, superintendent of mills for the Alaska Gold Mines Co., Thane, Alaska, is in San Francisco.

F. S. Norcross Jr. has passed the examination for a commission as Captain in the U. S. Engineer Corps.

Hugh R. Van Wagenen is at Tonopah working on the suit between White Caps and Manhattan Morning Glory.

E. J. Carlyle and M. R. Hull have opened an office for the Sissert copper company, operating in Russia, at Salt Lake City.

William Roberts, of Penaporth, Cornwall, has gone to Mexico as manager for the Avino Mines Ltd. at Gabriel, Durango.

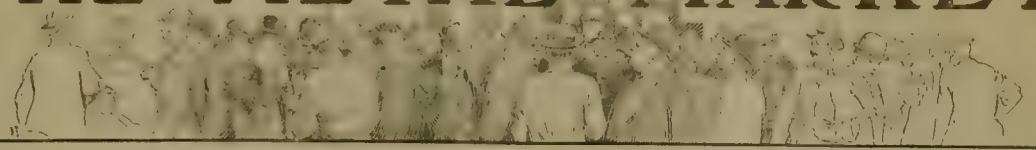
C. H. Macnutt, Lieutenant in the Canadian Engineers, has been transferred from the firing-line to an important home service in England.

A. C. Lawson has been elected chairman of the San Francisco section of the A. I. M. E., with W. H. Shockley as secretary and treasurer.

W. A. Miloche has been appointed to the Engineer Officers Training School from Camp Kearny, California, to Camp Lee, at Petersburg, Virginia.

Samuel W. Cohen, general manager for the Crown Reserve Mining Co., Ltd., has returned to Montreal after a six weeks trip in California and Colorado.

THE METAL MARKET



METAL PRICES

San Francisco, January 15

Aluminum-dust (100-lb. lots), per pound	$1 00
Aluminum-dust (ton lots), per pound	$0.95
Antimony, cents per pound	17 00
Antimony (wholesale), cents per pound	14.75
Electrolytic copper, cents per pound, in carload lots	23 50
Electrolytic copper, cents per pound, in small quantities	24.67½
Pig-lead, cents per pound	7.00— 8.00
Platinum, soft and hard metal, respectively, per ounce	$105— 113
Quicksilver, per flask of 75 lb	$125
Spelter, cents per pound	10.00
Zinc-dust, cents per pound	20 00

ORE PRICES

San Francisco, January 15

Antimony, 45% metal, per unit	$1.00
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0 70
Chrome, 40% and over	$0.70— 0 85
Magnesite, crude, per ton	$8.00—10.00

There is little demand for either calcined or crude magnesite.

Manganese: The Eastern manganese market continues fairly strong with $1 per unit Mn quoted on the basis of 48% material.

Tungsten, 60% WO_3, per unit	26.00

Tungsten ore remains firm.

Molybdenite, per unit MoS_2	$40.00—45.00

EASTERN METAL MARKET

(By wire from New York)

January 15.—Copper is quiet and unchanged at 23.50c. all week. Lead is quiet and higher at 6.70 to 6.90c. Zinc is inactive and steady at 7.87c. all week. Platinum remains unchanged at $105 for soft metal and $113 for hard.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Jan. 9	90.12	Dec. 4	84.70
" 10	90.12	" 11	85.70
" 11	90.12	" 18	85.38
" 12	90.12	" 25	86.42
" 13 Sunday		Jan. 1	86.62
" 14	90.12	" 8	88.66
" 15	89.62	" 15	90.04

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	48.85	56.76	75.14	July	47.52	63.06	78.92
Feb.	48.45	56.74	77.54	Aug.	47.11	66.07	85.40
Mch.	50.61	57.89	74.13	Sept.	48.77	68.51	100.73
Apr.	50.25	64.37	72.51	Oct.	49.40	67.86	87.38
May	49.87	74.27	74.61	Nov.	51.88	71.60	85.97
June	49.03	65.04	76.44	Dec.	55.34	75.70	85.97

Silver has undergone very little fluctuation during the past week and is now quoted at 91⅛c. per ounce.

Samuel Montagu & Co. says: The Transvaal gold output for November amounted to £3,070,426, as compared with £3,326,253 in November 1916 and £3,191,279 in October 1917. The total up to the end of November is only £35,255,282, compared with £36,195,229 during the same period in 1916.

The Shanghai exchange continues firm; possibly there is some connection between this strength and the approach of the Chinese New Year, which falls on February 11. On December 12 the official rate, 4s.3d., the highest received in recent years, approximates within a fraction the point at which silver could be shipped at a profit from San Francisco, but it should be remembered that silver transactions of this character need a license from the United States government. No fresh news has come to hand with regard to the projected purchase by the British and American governments; pending some definite details the market remains somewhat inert. It is proposed in France to demonetize silver coin bearing the effigy of Napoleon III crowned with laurel. The object in view probably is to extract the large quantities of such coin now hoarded, to re-coin pieces with a new die from the metal thus made available, and then issue them as required. It is anticipated that by this means the need of purchasing fresh silver for coinage will be reduced.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Jan. 9	6.70	Dec. 4	6.50
" 10	6.70	" 11	6.50
" 11	6.70	" 18	6.50
" 12	6.70	" 25	6.46
" 13 Sunday		Jan. 1	6.50
" 14	6.85	" 8	6.65
" 15	6.90	" 15	6.75

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	3.73	5.95	7.64	July	5.59	6.40	10.93
Feb.	3.83	6.23	9.01	Aug.	4.62	6.28	10.75
Mch.	4.04	7.26	10.07	Sept.	4.62	6.86	9.07
Apr.	4.21	7.70	9.38	Oct.	4.62	7.02	6.97
May	4.24	7.38	10.29	Nov.	5.15	7.07	6.38
June	5.75	6.88	11.74	Dec.	5.34	7.55	6.49

The trust price of lead has been advanced to 6.50c. per lb. with outsiders quoting above this figure.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Jan. 9	23.50	Dec. 4	23.50
" 10	23.50	" 11	23.50
" 11	23.50	" 18	23.50
" 12	23.50	" 25	23.50
" 13 Sunday		Jan. 1	23.50
" 14	23.50	" 8	23.50
" 15	23.50	" 15	23.50

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	13.60	24.30	29 53	July	19.09	25.66	29 67
Feb.	14.38	26.62	34 57	Aug.	17 27	27.03	27 42
Mch.	14.80	26.65	36.00	Sept.	17.69	28.28	25.11
Apr.	16.64	28.02	33.16	Oct.	17.90	28.50	23.50
May	18.71	29.02	31.69	Nov.	18.88	31.95	23 50
June	19.75	27.47	32.57	Dec.	20.67	32.89	23.50

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Jan. 9	7.87	Dec. 4	8.00
" 10	7.87	" 11	7.91
" 11	7.87	" 18	7.75
" 12	7.87	" 25	7.75
" 13 Sunday		Jan. 1	7.87
" 14	7.87	" 8	7.87
" 15	7.87	" 15	7.87

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	6.30	18.21	9.75	July	20.54	9.90	8.98
Feb.	9.05	19.99	10.45	Aug.	14.17	9.03	8.58
Mch.	8.40	18.40	10.78	Sept.	14.14	9.18	8.33
Apr.	9.78	18.62	10.20	Oct.	14.05	9.92	8.32
May	17.03	16.01	9.41	Nov.	17.20	11.81	7.76
June	22.20	12.85	9.63	Dec.	16.75	11.26	7.84

Spelter is entirely unchanged with prices ranging from 7¾ to 8 cents.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending			
Dec. 18	115.00	Jan. 1	130.00
" 25	115.00	" 8	130.00
		" 15	125.00

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	51.90	222.00	81.00	July	95.00	81.20	102.00
Feb.	60.00	295.00	128.25	Aug.	93.75	74.50	115.00
Mch.	78.00	219.00	113.75	Sept.	91.00	75.00	112.00
Apr.	77.50	141.60	114.50	Oct.	92.90	78.20	102.00
May	75.00	90.00	104.00	Nov.	101.50	79.50	102.50
June	90.00	74.70	85.50	Dec.	123.00	80.00	117.42

TIN

Prices in New York, in cents per pound.

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	34.40	41.76	44.10	July	37.38	38.37	62.60
Feb.	37.23	42.60	51.47	Aug.	34.37	38.88	62.53
Mch.	48.76	50.50	54.27	Sept.	33.12	36.66	61.54
Apr.	48.25	51.49	55.63	Oct.	33.00	41.10	62.24
May	39.28	49.10	63.21	Nov.	39.50	44.12	74.18
June	40.26	42.07	61.93	Dec.	38.71	42.55	85.00

There is no market in New York at the present moment for spot tin as no material is to be had at any price. Straits tin for shipment is quoted 64 to 65c., while Banca tin, of which some is said to have been sent by express overland, is reported sold at 70c. per pound. However, the tin position is exceedingly difficult at the present moment and is practically a sellers market.

Charles Hardy says: The past week has seen business started for the new year in tungsten ore, and while most of the business was done in off-grade ore, some high-grade ore was sold at prices ranging from $24.50 to $25 per unit. The business in off-grade ore was quite considerable and cleared out a good many lots which had been on the New York market for some time. The business, however, still meets with a lot of difficulty as it is hard to get ore sold on account of freight conditions in New York. As soon as shipments can be made with more regularity, the business in tungsten should improve. Business was also started during the past week in molybdenite at unchanged prices of $2.25 to $2.30 according to grade.

The antimony market remains non-existent. First hands decline to make prices believing that ultimately the market will recover and material in second hands which can be had at concessions is not sold as buyers are prominent by their absence.

Manganese remains unchanged with the January schedule at $1.20 delivered at the furnace for high-grade ore.

High-grade chrome ore is still quoted at 90c. per unit, f.o.b. shipping point, and small business has been reported.

The magnesite market remains practically the same. A few inquiries, however, are in the market for small lots but the market has not shown the expected strength as yet.

California virgin mercury has dropped to about $120 per flask of 75 lb. net, while Mexican is quoted around $115 for spot material.

Eastern Metal Market

New York, January 9.

The markets are all quiet and do not present any unusual features. Readjustment of accounts and the appraisal of stocks explain in part the dullness.

Copper is moderately active at the Government prices.

Tin is nominal, high, and still scarce.

Lead is firmer and stronger in tone at higher levels.

Zinc is again lifeless at unchanged prices.

Antimony refused to be excited and continues to sag.

Unprecedented low temperatures in the East and blizzards of large proportions in the West have seriously interfered with pig-iron production, and have added to the difficulties already present because of railroad congestion. Some steel plants are operating at only 50 to 75% of capacity. The industry has never been so badly crippled. December pig-iron output was low (only 2,882,919 tons) or 92,997 tons per day, against 3,205,794 tons, or 106,859 tons per day, in November. The relation of supply and demand is secondary to Government price-fixing. An important question for buyers to consider is: If there are new prices April 1, will they apply to deliveries carried beyond that date, even though contracted to be delivered in the first quarter? They will, according to reliable sources.

COPPER

Government demand for copper is reported as becoming larger in volume as the weeks go by and this is also true of that of the Allied governments. Domestic manufacturers, working more or less directly for the Government, are also buying more metal. There seems to be a good demand from wire mills. The volume of all of this business is large and it is going at the regulation Government prices of 23.50c. for carload lots or more, and at 24.67½c. for less than carload lots, with every prospect of sufficient copper to meet all needs. Nothing more is heard of a change in the fixed level, and it seems assured that this subject will not come up again for some time. The jobbers report that they have frequent requests for copper at 23.50c. because the conditions under which they have taken certain Government orders stipulate that they must not pay more than 23.50c. for the copper they use. In such cases, the jobbers have had to refuse the business at less than 24.67½c. How such small orders are being handled no one seems to know unless the Copper Producers' Committee is taking care of just such small business on Government account. One jobbing dealer in New York states that he is doing a good business at 24.67½c. for general consumption. There is some talk that the fuel scarcity, combined with railroad congestion, may lesson output at refineries, but only time can answer this. The output of refined copper from primary sources in 1917, according to preliminary figures of the U. S. Geological Survey, just issued, is estimated at 2,362,000,000 lb., compared with 2,259,000,000 lb. in 1916, and 1,615,000,000 lb. in 1913.

TIN

A small lot of Straits tin was sold at 80c., New York, on January 2 but this is the only transaction noted in many weeks. There is no spot market, and quotations are entirely nominal at about 85c., New York, with no prospect of the acute scarcity being relieved in some time. There has been in the last two weeks a big decline in the London market which reached its climax about January 3, which probably explains the 80c. sale referred to. There is no other explanation. Since then the London market has advanced suddenly, due perhaps to permit negotiations, though the real reasons are not known here. On January 7 the London quotations for spot Straits was £282 per ton, as compared with £272 on January 3 and £309 10s. on December 21. Recently in New York a few buyers got their courage up and went into the market, buying in two days an estimated tonnage of 200 to 300 tons of futures, mostly Straits, with some Banca and Chinese included. This is a decided improvement over recent weeks. The rank and file of purchasers, however, are still refraining from purchases, preferring to wait until conditions are more settled. Arrivals to January 3 inclusive have been 460 tons.

LEAD

After many weeks of practically one level the lead market has advanced, due to a change in the quotation of the leading interest. The American Smelting & Refining Co. on January 3 raised its New York price ¼c. per lb. to 6.50c., New York. This was followed on the next day by the independents who advanced their price to 6.70c., New York, or 6.55c., St. Louis. The reason for the advance by the Trust is generally conceded to be that because Government purchases are being settled on the average St. Louis price and because its New York price was lower than the St. Louis, an advance was proper. The result of the action has been to make the tone of the market stronger and firmer. Business, however, has been only of moderate proportions, due to a lack of sellers as much as anything. Spot lead is held at 6.75c to 7c., New York.

ZINC

The market has relapsed into its former lifeless condition and it is not strong. The prevailing quotation for prime Western for early delivery is 7.62½ to 7.75c., St. Louis, or 7.87½ or 8c., New York, at which levels a little business has been done, but it is not likely that the larger producer would be willing to seriously consider a large inquiry at these levels. It is understood that the 4000-ton inquiry for grade C for the Army's use has not been let. The bids on these were believed not to have been numerous, but it is the impression that the Government has been able to secure all it needed at the quotations obtained on the 1000-ton purchase for the Navy, referred to in previous letters. The expectation is that the U. S. Geological Survey's preliminary statistics on the 1917 output of zinc, which will be out any day now, will show this to have been not very different from the 667,456 tons produced in 1916. Exports are estimated at slightly in excess of those for 1916 when there were 206,000 tons. One estimate puts the deliveries into consumption at about 400,000 tons in 1917, which is 58,000 tons less than in 1916, but larger than 1915 or any other previous year. Although weather and railroad conditions are interfering with the receipts of metal from the West, stocks seem sufficient here.

ANTIMONY

The spot market is lifeless at 14.50 to 14.75c. per lb. duty paid, New York. Considerable competition is anticipated for an expected Government inquiry for 200 to 300 tons for March-April delivery.

ALUMINUM

Virgin metal, 98 to 99% pure, is held at 36 to 38c., New York, for early delivery with the market quiet. Sales are reported at 37 to 38c. The Aluminum Company's contract price for ingots so far for 1918 is stated as unchanged at 38c. per pound.

ORES

Tungsten: Both high and low-grade ore has been sold at $24.50 to $25 per unit in 60% concentrate in the last week. Business is being more or less interfered with by the weather and freight congestion. Ferro-tungsten is obtainable at $2.35 per lb. of contained tungsten.

Molydbenum and antimony: Molybdenite is unchanged at $2.25 to $2.30 per lb. MoS_2, depending on the grade and some sales are reported at these levels. Antimony is unchanged with the market nominal.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

A NEW LEYNER MACHINE

The modern hammer-drill, using hollow drill-steel and air or water to expel the cuttings from the drill-hole is now the rule rather than the exception in practically all rock-drilling operations. There is considerable carelessness in the matter of keeping the hole in the drill-steel open. Wholly or partly plugged steels prevent proper functioning of the drill, the drilling-speed is retarded, water-tubes are bent or broken, and time is lost in tinkering or, as often happens, the drilling



LEYNER SHANK AND BIT-PUNCH

gang is idle while someone makes a trip to the shop after another drill-steel or water-tube. To relieve this condition the Ingersoll-Rand Co. has developed and is placing on the market, as an auxiliary to the 'Leyner sharpener,' a new device, the Leyner shank and bit-punch. This compact and simply constructed machine consists principally of a cast-iron pedestal, at the top of which are bolted the clamping and punching-cylinders and apparatus. The drill-steel is clamped by two jaws brought together by the movement of a pinion, operated by the clamping-cylinder through the medium of a rack on the extended piston-rod. The heat-treated steel punching-pin is attached to the piston of a punch-cylinder, and in such manner that it may be readily removed should occasion require. The front head of the punch-cylinder is provided with a clearance space around the punching-pin so that, on the extreme reverse stroke, air is exhausted against the heated pin, effectually cooling it. The maximum stroke of the punch is 6 in. An adjustable stop for the drill-steel is provided to regulate the distance to which it is desired to have the pin penetrate. The standard punching-pin is $\frac{7}{8}$ in. diam. for a distance of 2 in. from the end, and $\frac{3}{4}$ in. for the remainder. The operation of the machine is controlled by a single lever moving in a T-slot. A downward movement clamps the steel, and a further side-movement operates the punch. The operation of the control-lever locks the clamp-jaws before the punch can be brought into action. In like manner the punching-device must be in a neutral position before the clamp-jaws can be opened. This safety feature prevents action of the punch before the steel is firmly clamped and in perfect alignment. It will be noted that all moving-parts are protected from dirt, grit, and damage, by tight-fitting covers; likewise the operator is guarded from injury. The Leyner shank and bit-punch occupies a floor-space 22 by 44 in. and weighs 400 lb. A plank support is the only foundation needed.

ALBANY GREASE

Fifty years ago the firm of Adam Cook's Sons was incorporated as the Albany Lubricating Compound & Cup Co. in Albany, New York. The firm was founded by Adam Cook. The history of Adam Cook's Sons is the story of the growth of 'Albany Grease' and that is the record of grease lubrication from its infancy up to the present time. Prior to 1868, oil was the only practical medium by which lubrication could be secured on mechanical work. Lubrication in those days was costly and not efficient. The stumbling block in oil lubrication was the exceedingly great amount of attendant waste. The trouble was the inability to keep a liquid in some sort of a container so that it would not run off or leak out until it had accomplished its object and until every lubricating atom in it was consumed in service. Adam Cook realized that it was highly improbable that any device could be secured to give the needed relief, and he selected the lubricant itself as the thing to be improved. 'Changed,' is the word that expresses what Adam Cook did, for in 1868 there was put on the market Albany lubricating compound, now familiarly known all over the world as Albany grease. That name was given to Albany lubricating compound by the engineers of the country. The point was willingly conceded, and soon the compound was re-christened 'Albany grease,' and has ever since been known by that name.

A small plant in Albany was erected at first, but within four years this became too small. In 1872, larger quarters were secured on the river front at 231 West street, New York City. Here was thought to be ample room for growth, but soon these quarters were outgrown, and in 1881, only nine years later, the business was moved again to larger quarters at 313 West street. As the business grew by leaps and bounds additions were made to the original building by the purchase of neighboring warehouses and the Albany plant soon ran through the entire block from West to Washington street. Despite the room available, the need of concentrated methods of production and the assembling of all departments presently made itself felt. In order to take advantage of the latest manu-

facturing methods, it was decided to bring into closer relations all the various departments of the business under a single roof. After a stay of 30 years, the West and Washington street plant was abandoned, and the modern commodious plant at 708-10 Washington street was placed in service. 'Albany grease' is celebrating its 50th anniversary and is receiving congratulations from an army of satisfied users.

NEW ORGANIZATION FOR LITTLE GIANT

After an existence of nine years as a department of the Chicago Pneumatic Tool Co., the motor-truck interests of the company were, on January 1, taken over by a new organization known as the Little Giant Truck Co. From small beginnings the motor-truck department of the Tool company had grown to such proportions that a separate organization became absolutely necessary. The growth was particularly marked during the past year. A good staff of active dealers, eager to ally themselves with a 25-year old concern, a complete line of motor-trucks from one to five tons capacity, the Duntley gas generator which permits the use of cheap fuels such as kerosene and distillate as an exclusive feature, all these have helped to build up the prestige of the 'Little Giant' truck and to practically double the volume of business during 1917. The factory at Chicago Heights has an amount of business on its books that will take months to complete, notwithstanding the increased facilities for manufacturing that recently have been added. At present, slippery streets, the rising cost of horse-flesh and horse-feed, the shortage of labor, the unqualified endorsement of motor-trucks by the railroads in the present traffic congestion, are factors which induce optimism for the motor-truck business. The Little Giant Truck Co. is owned and controlled by the Chicago Pneumatic Tool Co., and the officers are the same: W. O. Duntley, president; W. B. Seelig, secretary; L. Beardsley, treasurer; with T. J. Hudson, sales manager. The headquarters will remain in the Little Giant Bdg., 1615 Michigan Ave., as heretofore.

FREE INSTRUCTION IN TRACTOR AND MOTOR-TRUCK DRIVING

How to use gas tractors with the greatest efficiency, and how to lengthen their lives and increase their usefulness by keeping them in perfect repair, such is the object of the 'short course' to be given by the University of California at the Experiment Station at Riverside from February 11 to 16. The University points out that, with the present limited supply of labor, it is the patriotic duty of every owner of a tractor to see that his tractor does as much work and as good work as possible. Proper training for the operator and proper care of the machine are of the first importance. This tractor course will be similar to one recently held at Davis, where 184 people learned how to operate and to repair tractors. There will be lectures, illustrated with charts and models, on gas-engine principles, fuel, carburetors, magnetos, timing, adjustment, and all details. Instruction is given by experts from various factories as to the construction, repair, and operation of the eight or more makes of tractors to be used. There will be field demonstrations on the operation of tractor-machinery and tests of horse-power will be made. Each student will have an opportunity for practical work in soldering, pipe-fitting, carburetor-adjustment, bearing-adjustment, ignition-timing, belt-lacing, and the like. The course is open only to those who can show that they will be able to make definite use of the knowledge gained. The only expense will be a registration fee of one dollar.

C. P. Coleman was elected president of the Worthington Pump & Machinery Corporation, at a meeting of the board of directors, held on Monday, December 31, 1917.

COMMERCIAL PARAGRAPHS

Gustave A. Overstrom and Charles V. Craig have made a contract for handling the 'Universal' concentrator, covered by application for patent, serial number 132,387. Mr. Craig undertakes to manufacture and sell the machines, becoming half owner of the patent right.

'Caterpillar Times' for December last, tells of the extraordinary feats performed by the many types of caterpillar trucks and tractors produced by the Holt Manufacturing Co., Inc., of Stockton, California. One achievement is plowing up 35 to 50% grades in the State of Washington. Other machines are shown engaged in threshing grain, harvesting beans, logging, and doing work in road-building.

'Standard Oil Bulletin' for December gives praise to Japan in a look across the Pacific for commercial expansion; tells the story of Tom Orr's Ford car, the oldest active representative of this brand in California; a pleasant review of certain mascots; and then offers an interesting discussion of viscosity of oil and the critical velocity in pipe-line transportation. There is also a list of the employees of the Standard Oil in California who have joined the colors.

There was placed in service in December for the Cerro de Pasco Mining Co., Peru, a 3000-kw. hydro-electric plant. The company already had one plant of 9000 kw. In December the Homestake Mining Co. started, at Spearfish, South Dakota, a 4000-kw. hydro-electric plant, thus duplicating the former plant. Frank G. Baum, consulting engineer of San Francisco, had charge of the engineering construction of both the above plants, and has under way a 1000-hp. hydro-electric plant for the San Luis Mining Co., of Mexico.

A. Schwarz, consulting engineer, of Joplin, Missouri, has just completed an extensively equipped laboratory for physical and chemical testing, with a great number of flotation machines and all necessary auxiliary apparatus. The ore-testing plant is capable of handling one ton of ore, and contains practically every ore-crushing and grinding appliance and every concentrating machine of importance in use today. There are also in course of construction furnaces for all kinds of heat-treatment, and an electrolytic department.

'Duplex Doings, the Heavy Haulers' Magazine, for December, presents a paper on a new adaptation to trucks consisting of a power-windlass, which is of the self-contained single-drum type, with a drum 7⅝ in. diam. by 21 in. long, with a flange-diameter of 17 in. It is operated by a worm and worm-wheel from the transmission by a Whitney roller chain to the drum-shaft. The drum is operated by cone-friction, capable of handling a load of 10,000 lb. at a 4-in. radius. The rope-speed is 50 ft. per minute at an engine speed of 1000 r.p.m. The same issue contains articles with illustrations showing trucks adapted to house-moving, lumber-hauling, and other uses.

Don A. Carpenter & Co is in the field with a brand-new catalogue for 1918, being issue No. 10. It is a practical list of equipment for miners, contractors, quarrymen, irrigation engineers, and for those in charge of power-plants, pumping-stations, and general machine shops. The illustrations and descriptions are of the kind that enable the engineer and mechanic to definitely select what he requires, and full details for ordering are given so as to avoid mistakes. The firm is the El Paso agent for the compressors and other equipment made by the Chicago Pneumatic Tool Co., the pumps manufactured by the Goulds Mfg. Co., the Nagle boilers, shop equipment of the Canedy Otto Mfg. Co., the Champion Blower & Forge Co., and many other leading firms. The catalogue is well printed, and well-bound for service; it has useful tables and formulae for shop-practice, steam and water engineering, and for the use and control of internal combustion engines; and is also provided with an excellent index.

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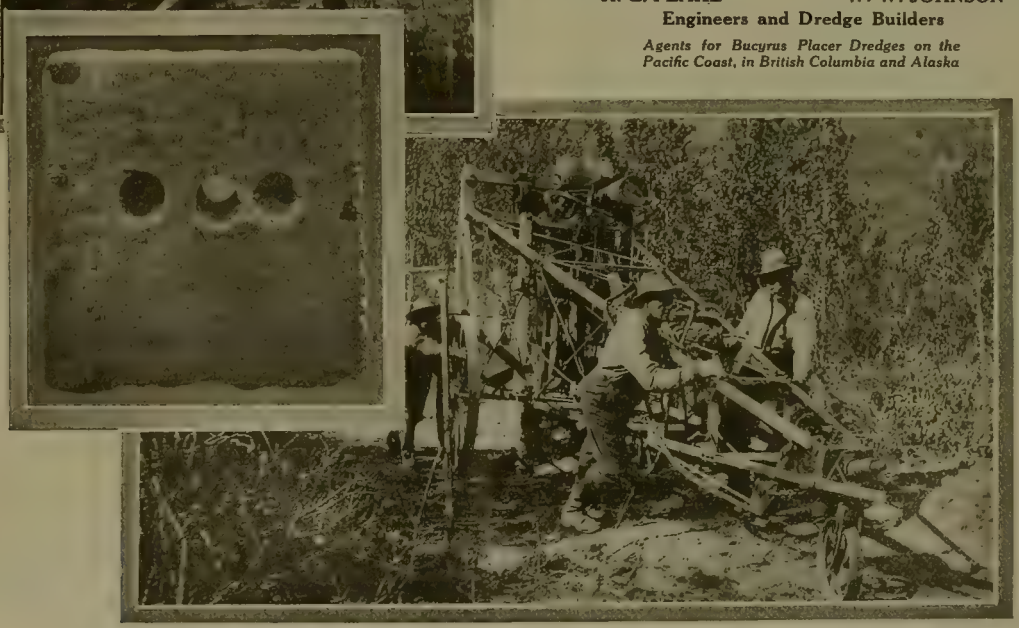
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EDITORIAL

IN these days of freight congestion it is worth while to draw attention to the large amount of useless printed matter issued, under an official frank, from Washington. For instance, we have been receiving reports from the Department of Agriculture and from the Board of Temperance. In both cases the printed matter went into the waste-paper basket, together with much similar stuff, because it did not bear remotely upon the subjects coming within our purview, as the senders ought to have known. And what of the hundreds of tons of piffle sent broadcast over the country by members of Congress? The abuse of mailing privileges by our legislators is a national scandal, and without humor in this hour of crisis.

PUBLICATION in a Colombian engineering journal of an estimate, by Enrique U. Ramirez, of the cost of building a railroad from Bogotá, the capital city of the Republic, to the head of navigation on the river Meta, brings to mind the circumstances of our negotiations with Colombia for the Panama Canal concession. President Marroquin demanded a cash payment, insignificant in comparison with what we paid the French company for assets of no great value, and the purpose that Marroquin had in view was the construction of this very railroad. That would have afforded the great Colombian plateau an outlet to the United States and Europe with only two transfers in transit against three by way of the Magdalena, and with infinitely easier gradients and lower costs. We did Colombia a wrong at Panama that is keenly felt by our people; nevertheless the payment of 'conscience money,' as once was proposed, would only deepen the sting. It would be a practical thing, however, to finance this needed artery of commerce for Colombia and thereby help to develop the resources of that country.

WE have read portions of the January bulletin of the Institute with cynical amusement, on account of the frequent emergence, upon the surface of its pages, of several commercial controversies regarding the merits and demerits of sundry machines. The editor of the bulletin, and therefore of the transactions, has our understanding sympathy in his effort to steer a straight course among these shoals of trade rivalry. We think that the publications committee of the Institute should consider seriously the knotty problem of distinguishing between technical disputation and trade controversy. We have animadverted more than once against the sort of paper that is a carefully prepared advertisement, for example, 'The Smith table' by Smith himself, or 'The Jones classifier', by the Hon. Jones. The volumes of the transactions of the Institute include several such trade propagandas. Now we are treated to violent disputes over the efficiency and deficiency of sundry machines. We doubt whether such disputes are advantageous to anybody. They have no value as technical evidence, because the testimony is bitterly partisan, and they are used equally to disparage the rival products. If the bulletins and the transactions are to echo the advertising pages of the trade press, then one rule should be put in force, namely, that any member of the Institute expressing an opinion on a machine should state his business connection, if any, with the manufacture of that machine or of any competing machine. Some of us may not need this information but the student of technology and the seeker after trustworthy information, whether reading the bulletins or perusing the same matter in its embalmed form in the bound volumes of the transactions, should be given this necessary warning.

ON January 14, after two months deliberation, Judge Wolverton of the U. S. District Court at Portland, Oregon, handed down his decision on the application for a temporary injunction in the case of American Smelting & Refining Company *v.* Bunker Hill & Sullivan Mining & Concentrating Company. In substance the Court holds that until the trial of the case upon its merits the Bunker Hill should continue to ship to the smelting company all its product containing more than 30% and less than 75% lead, but that the Bunker Hill could smelt its products outside these limitations or dispose of them as it saw fit. As a condition to the granting of the injunction, the Court first required a bond in the sum of $20,000, which amount has since been increased to $250,000. In the course of the opinion the Court suggests that the Bunker Hill had the right to dispose of its high and low-grade products, but that the company should not be at liberty to deviate from the custom and practice that it had followed in the years immediately prior to the controversy. We understand that the inter-

mediate product includes about half the tonnage of lead and ore produced by the Bunker Hill. The Court states that its opinion is not conclusive, but is a preliminary statement for the purpose of determining what should be done in advance of a full trial. The opinion is too long for publication, but we may mention that the Court holds that the Bunker Hill contract was assignable by the Tacoma company to the American Smelting company, and that the Bunker Hill company apparently anticipated such transfer. In referring to the contention of the Bunker Hill that the American Smelting company had formed a combination with other smelting companies to prevent the Bunker Hill from securing a market for such of its products as were not covered by the fixed terms of the contract, the Court says: "Another suggestion is that the American Smelting & Refining Company has brought about an unlawful combination with other smelting companies, so that it has a monopoly of the market for the purchase of lead ores, and for that reason that it ought not to be allowed to prevail here. While there is a surmise that such may be the case, the testimony in the record falls far short of establishing the fact."

THE War Minerals Committee has taken the position that iron, copper, lead, and zinc are not of practical importance as subjects for their consideration, because the supply of these metals is reasonably assured. They have, however, given special attention to the encouragement of domestic production of pyrite and manganese. To ensure an increase in the output of these materials it is essential to guarantee prices for a sufficient period to warrant the outlay that would be incurred in developing the available deposits. Although spot prices for domestic pyrite, for example, range from 25 to 30 cents per unit of contained sulphur, the sulphuric-acid makers will not quote such figures for future delivery. The result is to discourage the opening of new mines. Similarly, offerings of manganese lead to no transactions unless accompanied with samples and a firm proposition to deliver stated quantities ready for prompt shipment. Uncertainty as to the duration of the War is responsible for these limitations, and the only remedy is for the Government to give to possible producers assurance in some form of a return that will enable them at least to cover their outlay. The Government is furnishing the money to enlarge existing acid-plants, and it would, therefore, seem logical to foment the output of the requisite raw material. Members of the Committee suggested that the price might be stabilized for two years. That would afford some warrant for development, but it would still leave the question of disposal of the product at the Government price subject to a demand that might fail. This aspect of the matter led the Committee, with the approval of the War Industries Board, to recommend to the President that a sum of $5,000,000 be made available by the Bureau of Mines for making definite contracts for 18 months or more for an increased supply of pyrite to be delivered to plants, designated by the Government, from which it buys its sulphuric acid. This action is constructive and meritorious. Similar aid might be extended with propriety to producers of manganese and some other needed minerals.

Mining After the War

Under present conditions the financing of mining operations should be made with an expectation of impending changes in demand and in corresponding market-prices. We limit ourselves necessarily to the speculative mining field, without extending the argument to other branches of industry. No one will accuse us of pessimism in saying this, since we are thereby actually emphasizing the optimism of the Government in declining to fix metal prices for periods longer than four months. That means, primarily, that the Government is not convinced that hostilities will be greatly prolonged, in which event it would not continue to be a heavy purchaser, in view of the fact that its present authority for extraordinary expenditures is for the duration of the War only. No continuance of a general programme of military preparedness beyond the War has been arranged, and a great proportion of the Government contracts are on the basis of cost plus 10%. Therefore the completion of such contracts is not obligatory. Stoppage of further outlay may be ordered when desired by providing compensation for work done to the time of rescinding orders. The United States is the virtual purchasing agent for the Allies, and their credit in our market at this moment is essentially Uncle Sam's credit, since foreign settlements are effected through warrants drawn on our National Treasury against credits authorized by Congress. It must be noted that commercial foreign credits will be practically nonexistent at the moment of declaring peace, and also for some time after a treaty of peace has been signed. The peace negotiations will involve so many difficult problems that of necessity the sittings of the council will be lengthy. An armistice pending these negotiations cannot permit continuance of military preparations. The market demand for raw material will, accordingly, be subjected to conditions for which no provisions have been made, and prices, at best, will be 'nominal.' Trading for a time would practically cease. We must be careful lest we be precipitated from our paradise of high prices into a *limbus fatuorum*. It is our firm belief that the Government, having taken upon itself the useful function of regulating prices, should also appoint one more committee for the purpose of drawing a well-considered plan leading to some appropriate legislation for protecting industry against the collapse that otherwise threatens to ensue as soon as the guns cease firing. Such a disaster may not be scorned because it may be only temporary. It is well enough to bolster our optimism by talk of reconstruction after the War, but it will take months to arrive at an acceptable treaty, and more months to develop an extensive programme of reconstruc-

tion and to establish the banking credits on which business may proceed. This will involve a serious check upon industry, a shortage of work for all classes of labor, discordant prices, financial timidity, and money stringency, unless wise provision to bridge that period of uncertainty be made in time. Meanwhile the larger mining operations are being based on a possible return to pre-War prices, at a reduced output, and new ventures should be directed in the light of a safe market no further ahead than the guarantee of prices by the Government.

Unto the End

We are living in days when successive crises fail to shock our imagination, just as the frequent recital of horrors makes callous our feelings. Nevertheless the moment is full of significant events. The pronouncements of the Premier of Great Britain and the President of the United States have been published so nearly together as to emphasize the essential solidarity of the two English-speaking nations and to hearten their peoples with the assurance that the two governments know what course they are steering. The War has reached that crucial stage when the actual fighting is subordinated to political considerations, because the apparent absence of a decision on the battlefield is joined to the hardships that winter brings upon the warring peoples. The men at the front—our gallant defenders in the trenches—do not doubt the issue, we do not doubt them, but they are asking if the people at home will see it through, if they will hold firmly to the end. Signs multiply that the nations of Europe are weary of fighting, they count their losses and ask anxiously 'How long'? Lack of food and fuel begins to sap the ardor of the onslaught. This is the moment when the quitter falters and the sticker stays; in conventional language the morale of some of the belligerents appears to be weakening. Shall frightfulness triumph over a blood-soaked world; shall the outlaw be conciliated with fresh scraps of paper? France lifts a mournful face in which firm resolve gleams undismayed; Britain smiles with the set teeth of a bulldog; America raises her hand and shouts, 'We come!' If there is to be any quitting, it will not be among these. Our leaders have stated our aims—enough of that—it is hits that count henceforth. Peace talk, with its poison gas of bolshevik anarchy, must await the only conclusion that will restore civilization. Germany has seceded from civilization. The world cannot remain half-slave and half-free. Either this canker of military ruthlessness must be cut out or we relapse to a scientific barbarism. Are we to be cogs in an infernal machine or citizens each in his own democracy, free to live and let live? It is one or the other. The Prussian has not changed the spirit of his paranoiac dream, the Pan-German still hopes to make good his will to conquer. A few days ago General von Lieb in a speech before the German Conservative Congress said: "We must recognize only one principle, namely, that might is right, and must know neither sentiment, nor consideration of humanity, nor compassion. We must have Belgium and northern France. The curse of God is upon the French. France must be bled white. We must have a strong peace." There speaks the voice of the beast with the brains of an engineer, undaunted by the world's reprobation, unfeeling for the butchery he has provoked. In every great war there comes a moment when the issue seems either doubtful or unsettled; that is the moment when moral courage gives a new edge to physical bravery. Such a time came after three years of the Civil War; such a time came in the Napoleonic struggle after the battle of Friedland, when the Allies signed the treaty of Tilsit and legalized Napoleon's conquests, thereby committing Europe to eight more years of warfare. At Friedland the Russian army was so badly beaten that the Czar and the King of Prussia capitulated. But England continued to fight Napoleon in Spain and on the sea, and by her tenacity of purpose eventually rallied the Allies to final victory at Waterloo. France, England, the United States, and their allies, mean to fight to a sure decision, although it is likely to be brought about not by any single battle but by a steady hammering of the Enemy. We are fighting for peace, for a peace that shall endure, not a patched-up truce enabling the Enemy to re-organize himself for another spring at the throat of civilization. A treaty with an outlaw is a scrap of paper. Our aim is to create a league of nations committed to the preservation of international order. Shall we ever have a league more effective than the one now existing among the Allies? If this league cannot bring the breaker of the peace to his knees then no imaginable combination in the future can do so. Now is the chance to prove to the world that predatory militarism is a punishable crime, that it is incompatible with social progress, and that a majority of civilized nations is ready to check it with all the resources of outraged humanity.

The Fuel Order

On January 17 Mr. H. A. Garfield, the head of the U. S. Fuel Administration, issued an order for regulating the supply of coal throughout the country, for the purpose of expediting the shipment of supplies of war from our ports to our own army and to the armies of the Allies in Europe. In order to accomplish this purpose an executive mandate was issued, forbidding the burning of fuel by manufacturers east of the Mississippi river, except those engaged in a few classes of work connected with the War, on January 18 and for four succeeding days; also on every Monday from January 28 to March 25. This order evoked many protests and much verbal confusion. Four pronouncements of opinion should be noted. Mr. Samuel Gompers, speaking for the American Federation of Labor, said that the workers of the Nation will be the greatest sufferers from the fuel restriction order, but "they will maintain their loyal stand, despite the suffering and sacrifices which they may be called

upon to bear." The War Service Executive Committee of the Chamber of Commerce of the United States issued a statement criticizing the order, but announcing that, since it had been issued, "it is clearly the duty of business men to do all in their power to carry out its spirit and purpose." Mr. Elbert H. Gary declared on behalf of the United States Steel Corporation: "We probably shall not pay the wages of our men when they are not actually employed. To do so would be contrary to the custom of the trade, and would establish a precedent which eventually would be unfair to the employer as well as to the employee." At the close of an explanation issued by Mr. Garfield himself, he said: "This is War! Whatever the cost, we must pay, so that, in the face of the enemy, there can never be the reproach that we held back from doing our full share. Those ships laden with our supplies of food for man, and food for guns, must have coal and put to sea." These four statements will, we believe, reflect the opinion of the intelligent portion of the public. The existing shortage of fuel does not represent inability to move the quantity normally consumed. On the contrary, more coal has been delivered by the railroads during the year 1917 than ever before in the history of the country. The Geological Survey estimates that the output of the mines was approximately 50,000,000 tons greater than in 1916, and in that year the record of previous production was broken. The National City Bank of New York is responsible for the statement that practically no stocks of coal exist outside consumers' hands. The evidence clearly indicates that two factors have produced the unusual situation that the Government undertook to meet by a suspension of manufacturing. These factors are, first, increased fuel consumption resulting from the intensive production of supplies for War, in addition to those needed for domestic use, and, second, the inadequacy of transportation facilities to cope with the vastly augmented tonnage of coal necessitated under these unusual conditions. The difficulty has been aggravated by an exceptionally severe winter, involving a suddenly enlarged demand for household purposes, at a moment when the railroads were further crippled by snow-blockades and the many impediments to operation that follow from excessively low temperatures. Mr. William M. Calder, in the Senate, called attention to the fact that the Fuel Administration had interdicted the buying of coal during the summer season, declaring at that time that the shortage was psychological rather than real, and that the accumulation of such supplies for household or other requirements would be deemed hoarding. It will be remembered that the failure of the railroads to handle successfully the growing volume of freight was the subject of a special report by the Federal Trade Commission presented to Congress as far back as June of last year, coupled with a definite recommendation for Government control of the transportation systems. The inevitable conclusion from all the facts is that there has not been proper co-ordination of the governmental departments, bureaus, and committees that are responsible for the practical work of directing the activities of the country. In consequence of this lack of co-ordination the welfare of the people and our preparation for the business of War have suffered. This criticism has been repeated frequently by many sincere and earnest patriots on the floor of Congress and in the press, but it has gone unheeded. In the storm of Congressional debate provoked by Mr. Garfield's order a number of Senators accorded the President the warmest praise for untiring devotion to his overwhelming duties, but they reminded him that he was attempting the impossible in personally struggling with such multitudinous details as the present administrative organization forced upon him. It is manifestly beyond the power of a single individual to harmonize the efforts of the numerous branches into which the executive authority of the Government has been subdivided to meet the exigencies of the hour. This had been so fully realized by Congress that bills were drafted by the Military Committee of the Senate just before the emergency fuel order was issued, providing for the appointment of a director of war industries, and for a non-partisan war cabinet of three members to stand between the President and the usual cabinet, the duty of which extraordinary council shall be specifically to co-ordinate the work now being performed by the several departments and special committees. It is fortunate that these bills were drawn before the flood of protest evoked by Mr. Garfield's action. Thus no sting of criticism is involved in them, and the President can accept the measures, if passed, in the spirit of constructive aid that prompted those who framed them. The country will also feel an added confidence in the conduct of the nation's affairs. No one can ignore the fact that popular confidence was rudely shaken by the drastic action that was taken to remedy the fuel shortage. It was a difficulty that apparently could have been avoided by greater foresight. Better organization will be needed now to assure a cordial settlement of the difficulties likely to arise from the temporary stoppage of so many industries. Heavy losses are sure to result, and it is plain that the burden will not fall equally upon those affected. Manufacturers operating on the basis of cost plus 10% can evidently pay their workmen during the period of idleness, charging the amount in their costs, while those operating independently would suffer without remedy. Already we see that prominent business men reject the plea to continue the payment of wages as a patriotic duty. No provision for compensation has been made by the Government, and if money is withheld from the laborers the consequent distress will necessitate instant relief, together with ample assurance against the recurrence of such painful incidents. That the action taken by Mr. Garfield was imperative under the existing circumstances will be accepted by the people with good grace, but those circumstances should not have been allowed to arise, and it is the duty of those in authority to grapple more firmly with the problems arising from the extraordinary conditions of war.



The Domestic Production of Chrome

The Editor:

Sir—the war meeting of the New York Section of the American Institute of Mining Engineers (sitting in joint session with the American Electro-Chemical Society in conjunction with the third National Exposition of Chemical Industries) was held to discuss the supply of raw materials for the manufacture of ferro-alloys. Chrome received the principal consideration.

The domestic production being only 47,035 tons as against an importation in 1916 of 115,945 tons, the question was raised as to how much could the United States supply from its own mines? Attention was also called to the apparent exhaustion of the known deposits.

No doubt there is plenty of chrome available in New Caledonia and Rhodesia, but to obtain this ore it becomes necessary for the United States to send ships that are at present needed to transport food to the Allies. If necessary we can, of course, do this, but is it an act of patriotism for our industries to compel our Government to import this ore without making a greater effort to develop our own deposits? I believe there is little question in the minds of the Western miners that if it were necessary the United States, with Alaska, could produce all the chrome ore demanded for the manufacture of munitions. There is, however, good reason for doubt, because, if the present policy on the part of our buyers is maintained, there will be considerably less offered in the future than is at present available. I refer to the secretive and non-cooperative policy maintained by the consumers of chrome ore in their effort to keep down the price of this raw material. I believe it is a mistaken and short-sighted policy on the part of the consumers not to offer more encouragement to domestic production, especially at a time when ocean-going space is in such demand.

It has been said that a rise in the price of this ore would not materially increase the production. I submit figures herewith showing the enormous increase in the production of this ore in the United States within the last five years due to the slight increase in price.

PRODUCTION OF CHROME ORE

Year	Tons	Price per ton
1913	255	$11.19
1914	591	14.75
1915	3,281	14.85
1916	47,035	35.00
1917	48,000	40.00

In order for us to consider thoroughly the question of how much the United States will produce it is necessary to investigate both the physical features surrounding the occurrence of chrome ore, and also the economic question under which these ores have to be marketed.

Chrome is widely disseminated throughout the Pacific Coast states; it is found in more than one-third of the counties of California, which alone produced more than 40,000 tons in 1916, or more than one-third of the total imports into the United States for that year. Chromite occurs in workable quantities in Oregon, Washington, and Alaska. These regions have been but little prospected for chrome and they will not be prospected until such time as the practical miner learns of the market value of such ore.

The consumers may send out all the expert mining men they wish to work these deposits but they are not going to develop a source of supply for a mineral hitherto considered worthless until they educate the practical miner, the prospector, and the farmer as to the value of it. They are not interested in chromite and unless an incentive is given they are not going to become interested; for that reason I am strongly of the impression that it would do much to stimulate the discovery and the opening of new deposits if more assistance and co-operation were given to the small producer, especially regarding publicity as to the true market-value of the various grades of chromite instead of making it as difficult as possible for him to ascertain the real value of his ore. He not only should know the value of a particular ore, but he should be able to ascertain the relative value of the different grades of ore and concentrate. There are many deposits of this ore slightly below the grade required by the consumer that, by simply crushing and concentrating, would furnish a high-grade chemical ore.

Chromite orebodies as a rule occur in relatively small deposits. J. S. Diller of the U. S. Geological Survey says the largest orebody yet mined on the Pacific Coast contained about 15,000 tons. Most chrome deposits are formed as a crystallization or segregation, during the process of cooling, of the chromite contained in molten igneous masses, and for that reason the mining of these orebodies is uncertain. There are many places where the mining of these pockety deposits, although not sufficiently attractive to pay for the operation and overhead expenses of a company, might be undertaken by the individual miner.

Although the buyers have succeeded in keeping the price of the raw chrome down within narrow limits, such a policy of secrecy is not to the welfare of the industry, and it certainly does not develop mines for production of

raw materials. Rather than the present policy of mystery, the producers should be made acquainted not only with the technical part of its production but also with the uses to which it is put. Although most of the writers upon the subject of chromite refer to its application in the refractory-brick business they present no figures showing the consumption of chrome in the steel industries, and the producer is left in the dark as to the use made of his ore and regarding the future demand.

As a rule, all that the miner or prospector wants is a sufficient return to permit him to do more mining, and if, perchance, he does make a profit in the mining of a few hundred tons of ore, he is more than likely to re-invest his funds in the search for additional deposits. A more liberal and frank policy practised by the industrial companies purchasing the raw ore would not only stimulate development, with the possibility of additional orebodies being found in the districts at present becoming depleted, but it would be cause for the investigation of the chrome fields at present unexplored in Washington, Oregon, and Alaska.

F. A. Rapp.

San Francisco, December 31, 1917.

Excess-Profit Tax for Mines

The Editor:

Sir—The proposal of Albert Burch, quoted in your editorial of January 12, as modified in the same editorial, comes near being a satisfactory solution without, I think, quite reaching it.

The problem is to secure for the State a large, but equitably distributed, share of the profits arising from increment in value of mining products, due to the War, without discouraging production from any source. It is in this direction that I think Mr. Burch's proposal fails. It is of the greatest importance to increase production, both because the metals are required for the effective prosecution of the War, and also because production tends to keep down prices. We need the production even if it is unprofitable or inadequately profitable; and the high-cost mine may furnish just that extra margin of product which may save us from runaway markets or actual shortage.

To secure both ends, the increment of price which should regulate the rate of taxation should be only that in excess of 50% above the average pre-war price (50% representing the estimated increase in costs, due to the War). The tax should, however, be assessed only on the profit actually made, not on the excess value of the products marketed. This will, of course, result in stimulating production from some mines which will have to close down after the War; but it is exactly this production that we need now. If we do not obtain it, sooner or later we may either risk failure on account of scarcity of essential metals, or be compelled to produce them at the expense of the State.

I would therefore re-state Mr. Burch's formula as follows:

In the case of mines, oil-wells, and gas-wells, the increase in the average price received at place of sale for each unit of product (that is, each ounce, pound, ton, barrel, or cubic foot, as the case may be) for the taxable year, over the average price at which the same unit was or could have been sold at the same place during the pre-war period, shall be ascertained; and the percentage of such increase beyond 50% shall be used as the basis on which the excess-profit tax shall be computed. The said tax shall consist of not less than 20% and not more than 80% of the entire profit for the taxable year. Whenever the percentage of increase of price of product as aforesaid shall exceed 50% the tax shall be 20% of the profit for the year, and whenever the percentage of increase of price of product shall be 200% the tax shall be 80% of the profit for the year; intermediate rates of increase of price of product fixing the war excess-profit tax at proportionately intermediate percentage of the annual profit.

This proposal would contemplate allowance for depletion, etc., remaining on the same footing as under the present law.

George E. Collins.

Denver, January 16.

Food Saving

The Editor:

Sir—Since last July we have been very busy re-building, after our fire, and making new trials, as we have changed the location of our buildings. I had no chance to read the Press until a month ago, when I picked up what magazines I had left from the fire and saw the Hoover 'ad,' and here it is signed and returned to you, as requested. I am *chef de cuisine* and food economist, so it will be my good fortune to help the cause a little. Wheat flour has gone up 100% since the beginning of the War, yet we pay less by $2 to $3 per barrel in Elk City than we paid for it 10 years ago; the parcels-post reduced our price here. From necessity of high prices, and the little work to be had, I evolved a wheat bread that is from 25 to 40% camouflage, a bread that tastes as fine as any Vienna roll ever did, and, according to Mr. Hoover's precepts, I am now saving from 25 to 40% wheat on every loaf I bake, although I have not a wheatless meal a week. Stale bread, pieces or whole bread, will make so many excellent dishes that there is no reason whatever for a single piece of bread, no matter how dry, to be wasted. The savings to be made by Mr. Hoover's plan will be enormous, unbelievably so; and the health of the nation will increase 100%. Let us all be Hooverized, voluntarily or by force.

Frederick Gribi.

Elk City, Idaho, January 4.

Nitrate of soda will be supplied for fertilizers by the Government this season at $75.50 per ton. The current market rate has dropped to $88 for 95% grades on the spot. It is said that larger amounts of Chilean nitrate are now afloat bound for this country.



CUT THROUGH COPPER MOUNTAIN. THE GAP REPRESENTS ORE REMOVED

Ajo Copper Mine—I

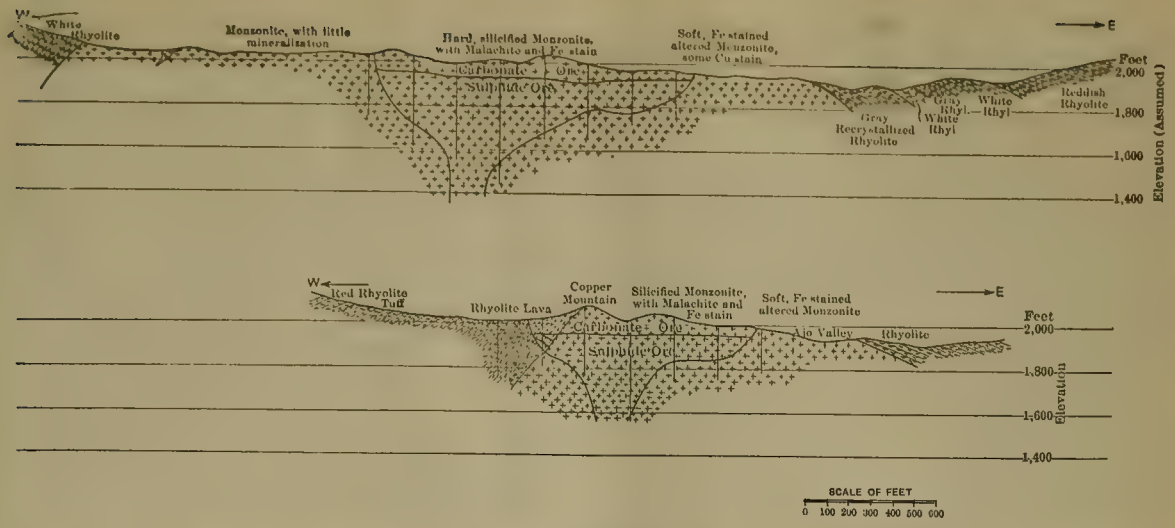
By COURTENAY DE KALB

At the town of Ajo, in the western end of Pima county, Arizona, is a copper mine now recognized among the great ones of the world. It is being worked by steam-shovels, and the ore is leached with sulphuric acid, after being crushed to ¼ inch. The monthly shipments of copper exceed three million pounds. The property is not yet completely developed, but 61,000,000 tons of ore averaging 1.51% copper has been definitely proved. This notable addition to the nation's available supply of that metal must be credited primarily to the courageous initiative and unflinching confidence of John C. Greenway. He was not alone in his conviction that Ajo would develop into a premier mine, for he was sustained by the mature judgment of L. D. Ricketts; but the least weakening of his own faith in the enterprise during the earlier period of development might have led to its abandonment. The degree of courage required may be inferred from the fact that Ajo labored under the burden of a history of successive condemnations by men of large experience in 'porphyry' mines. These were men who knew the characteristics of disseminated deposits; who understood the criteria of secondary enrichment; and they had even made tests by rather extensive drilling. In the end they withdrew, and nothing is more difficult than to resuscitate a mining district that has been investigated by competent engineers, supported by abundant capital, and then deserted as worthless. Moreover, Capt. Greenway, now major of engineers in France, whose military title was won as a Rough Rider in the Cuban campaign, faced a technical staff that was distinctly cold toward the Ajo mines. The first reports were not flatly condemnatory, but an adverse argument was involved in the faint praise given. He, however, was ambitious to sponsor a great disseminated copper property, and the features that had drawn his predecessors to look curiously at Ajo encouraged him to take the rather doubtful chances of success admitted by his advisers. In the end it proved that the earlier drilling had narrowly missed the important orebody, and that the expected enrichment did not exist, for the Ajo deposit has not been secondarily enriched. It consists of an upper zone of copper carbonate and a lower zone containing primary chalcopyrite and bornite. The difference in the copper content between the two is only 0.04%, with the higher proportion in favor of the carbonate. Acid leaching had been prevented by abundant calcite formed during a period of alteration that preceded the introduction of the copper, and sericite is so nearly absent that it can be detected only to a small extent by examination with the petrographic microscope. Thus it is evident that the Ajo deposit presents no analogies to the secondarily enriched 'porphyries' from which previous experience in disseminated copper ores had been gained. It was distinctly *sui generis*.

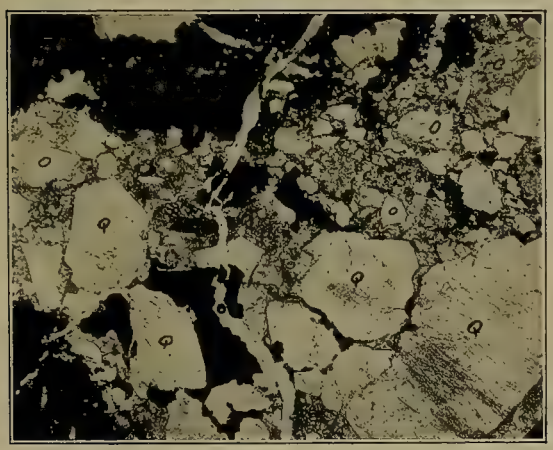
Part of the early history of Ajo has been given by Ira B. Joralemon.* He notes that, next to Santa Rita, New Mexico, it is the oldest centre of copper production in the South-West. Mr. Joralemon credits the first operation to the early 'sixties, but in reality the work began in 1855, and in the following year a shipment of high-grade ore was made to San Francisco by the Arizona Mining & Trading Co. This was a sort of company of gentlemen adventurers, organized in the spirit of true pioneering, with no more substantial objective than infinite hope in the possibilities of an unexplored country. The organizers were Major B. Allen, J. D. Wilson, William Blanding, A. S. Wright, and others resident at Los Angeles. An expedition was outfitted in that city in 1854, under the charge of E. E. Dunbar. It consisted of 20 men, among whom were F. Ronstadt, P. Brady, G. Kibbers,

*'The Ajo Copper Mining District,' Trans. A. I. M. E., Vol. XLIX, pp. 593-609.

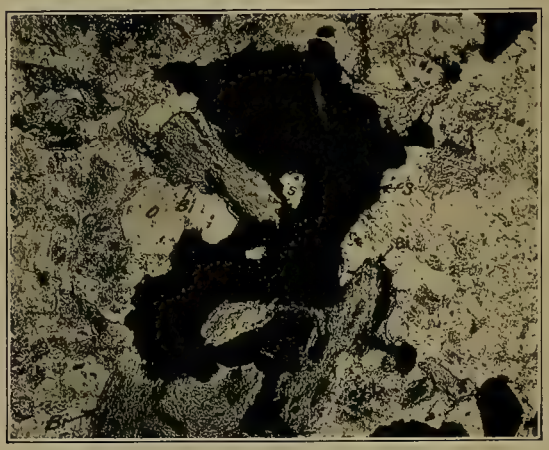
George Williams, Joe Yancy, Charles Hayward, and a Dr. Webster. They went first to Yuma, where the expedition was divided, one party, caught by the lure of a lost mine, plunging into the wilderness in quest of the ever elusive Planchas de Plata vein, while the other, following the trail to Tinaja Alta, heard of the Ajo copper mines 90 miles east-southeast from Yuma. They found these mines to be real, and soon established themselves in possession; but mining in Arizona in 1854 required familiarity with arms as well as with the pick. The new international line, as described in the treaty for the Gadsden Purchase, was still undetermined by survey, so the Mexican authorities undertook to wrest the mines away from the Americans, but they were defeated by effective resistance organized by Hayward. The first ores shipped came from excessively rich narrow deposits of cuprite and native copper, found near the contact between the intrusive monzonite and the older rhyolite, near the western end of the present workings of the New Cornelia Copper Co. Subsequently, rich narrow veins of chalcopyrite and chalcocite in the rhyolite were the source of ore that kept the district feebly and intermittently active for half a century. For a time the ore was hauled in ox-carts 400 miles across the desert to San Diego, and later it was taken to Yuma, to be floated down the Colorado river in barges to the head of the Gulf of California. From this point it was shipped to Swansea. The second period began about 1900, when a series of fiascos followed the attempts made by numerous companies to exploit the small rich deposits in the outlying region around the great mass of low-grade ore. Stamp-mills were erected, and patent processes for reducing and refining the copper were tried, among these being efforts to leach the ores with hydrofluoric acid. In 1909 a fresh venture was made, and this time by responsible people. The original New Cornelia Copper Co., one of the moribund concerns of the stock-promoting epoch, was taken under option by the General Development Co., and the holdings of the Rendall Ore Reduction Co. also were tested by a group of capitalists advised by Seeley W. Mudd. After a brief campaign of drilling both options were abandoned, but in 1911 Capt. Greenway took an option on the New Cornelia property for the Calumet & Arizona Mining Co. Instead of testing the low-lying areas around Copper mountain he directed his attention to the rugged group of hills that has proved to be the centre of mineralization. Mr. Joralemon describes these hills as being "highly stained outcrops." Whatever may have been the character of the central zone through which since then the steam-shovels have made a deep wide open-cut, the remainder of the area of 55 acres is surprisingly destitute of green coloration, except where broken in the course of exploratory work. The outcrop, however, is clearly marked; it consists of a number of low, barren, rocky hills surrounded by high peaks and ridges of gray granite and rhyolite. The prevailing tint of the encircling mountains might be described as pale grayish lavender. The copper terrain is distinguished by a warm russet hue, indicating an excess of iron. The form of the mineralized hills is rounded, but the bare rocks have a short angular fracture, and are encrusted with the desert glaze. Here and there a bit of copper carbonate appears, and a dark-green stain is not uncommon on sheltered faces of the rougher and larger blocks. A surprise comes, however, on breaking the rock with a hammer. No matter where one strikes it the stain of copper carbonate is revealed. It reaches up to the very crust of brown glaze that had obscured it; through every seam opened by the hammer, the green film penetrates. On breaking a few inches deeper the feldspars of the monzonite display a pale greenish tinge, and this minute coloration proves to be leachable, even without reducing the rock to a fine state of subdivision. Looking at the walls in the open-cut, as they are blasted down to feed the steam-shovels at their feet, the appearance is not that of ore but of rock merely permeated with greenish tints; and one recalls the common joke about a mountain stained with a copper cent. It seems, in fact, like mining a stain and making it pay. From this it must not be concluded that the ore is wanting in signs of richness. As finally broken ready for loading by the steam-shovel, the color of a pile of ore is dirty greenish gray, but on large blocks the seam-deposits are often thick and exceedingly brilliant in color. Turquoise-blue to verdigris-green are the prevailing shades. In places the incrustations are no more than a film, but more generally they constitute a scale of copper mineral that can be stripped with a knife, and many seams are found as much as an inch thick. This is in accord with the habit of the deposit. In monzonites that have not undergone profound alteration, such as sericitization or chloritization, the jointing developed in the final set of the rock is generally irregular; mineralization by sulphides follows the joint-planes, and, to a less extent, depending upon the degree of compression of the mineralizing gases, the sulphides invade the body of the rock, replacing primarily the ferro-magnesian minerals. This order is observed frequently, and it is seen in the Ajo deposit. The most striking feature to the eye, on examining the sulphide ore from the lower unoxidized zone, is the abundant deposition of the sulphides, both chalcopyrite and bornite, on seams and joint-planes. They form crusts and patches as well as crystalline flakes scattered quite regularly over the surface. Narrow veinlets of bornite and chalcopyrite suggest replacement of seams of segregated basic minerals, these being tightly coherent to the body of the rock, showing quartz often developed as prisms protruding into vugs. Cuprite occurs in the oxidized zone in the same manner; in fact, most of the recognizable cuprite is in veinlets cemented into the monzonite; some of the masses of cuprite would weigh a pound or more. Cuprite is also seen in such veinlets in the sulphide zone, where it is well crystallized, and of a dark color, but easily recognizable by the splinters that flash ruby-red by transmitted light. The copper sulphide is disseminated also, and appears to exist mainly as bornite. In the process of mineralization the volume removed has generally been in excess of that deposited, leaving the rock with a rough and minutely pitted sur-



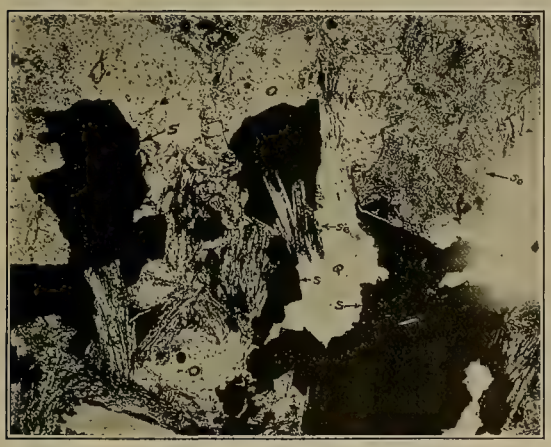
VERTICAL SECTIONS THROUGH NEW CORNELIA OREBODY



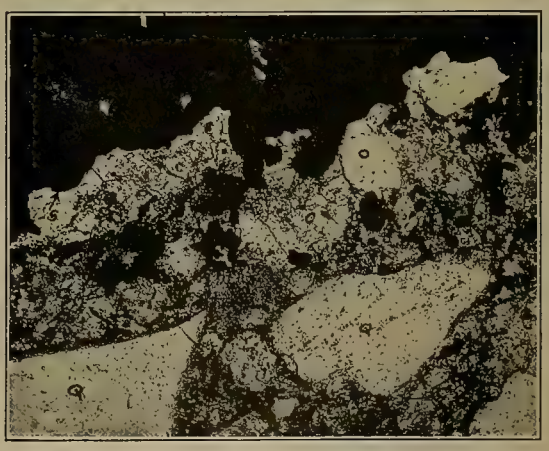
Calcite (C) replacing quartz (Q) and feldspar; sulphides (S) replacing all minerals. Note peculiar alteration of quartz. Mag. × 24.



Sulphides (S) replacing biotite (Bi); also chloritic alteration of biotite. Mag. × 71.



Bornite (black) replacing orthoclase (O); sericite (Se) replacing bornite. Chlorite (Cl); quartz (Q). Mag. × 91.



Calcite (C) replacing quartz (Q) and feldspars; sulphides (S) replacing all minerals. Mag. × 83.

THIN SECTIONS OF AJO SULPHIDE ORE

face; this is a feature observed in other examples of mineralized monzonite. Chlorite is general as a secondary mineral, having resulted from the alteration of biotite chiefly. Some siderite is also found; it is secondary, but is not always conclusively a product of the period of oxidation during which the copper was converted to carbonate. Much magnetite is present, and this, as well as specularite, is found with the ore, the specularite appearing most commonly on seams and joint-planes. Apatite is also abundant, but not to be detected in examination of specimens with a hand-lens. The phosphorus appears regularly as a constituent of the solutions in circulation through the leaching-plant, as shown by analyses of weekly composite samples, which contain from 0.162 to 0.184% of phosphoric acid. At times the solution holds 0.3% P_2O_5. The chlorine in the solutions is from 0.01 to 0.008%, and this, plus the chlorine deposited in the cathode copper, is fully accounted for by the chlorine in the water used for leaching, which carries 0.015%. The ore shows no chlorine whatever, hence the phosphorus is assumed to be present in the form of the fluo-apatite. The scarcity of sericite has already been noted, though it appears scattered rather abundantly through the mineralized rhyolite at the south-west end of the monzonite orebody.

The structural features of the deposit have been lucidly set forth by Mr. Joralemon,† who interprets the known relations of the monzonite as indicating a laccolith, over which the rhyolite is domed. Drill-testing, still in progress on the south-west side of the outcrop, beyond the point where the rhyolite is first seen shouldering over the monzonite, has penetrated to a depth of 1100 ft. and has not yet reached the monzonite. The drill-core, however, shows a great deal of native copper, so that it is apparently approaching near the zone of mineralization. This indicates, also, that the dip of the contact between the two rocks is becoming steeper. Whatever additional light this may throw upon the relation of the monzonite to the overlying rocks, it does indicate at least an approach toward its southern limit. Mr. Joralemon states that the monzonite laccolith, or 'batholith', which lifted the earlier rhyolite beds, is 10 miles long and of irregular width, varying from 1 to 4 miles, the direction of its major axis being N. 20° W. Toward the north the monzonite constitutes a series of high precipitous ridges, and in this portion of the exposure the facies is quite generally that of a coarse grano-diorite, with biotite prominently developed. Phases of more distinctly dioritic segregations are common, and Mr. Joralemon calls special attention to the fact that "diorite or diabase dikes cut both monzonite and rhyolite, but apparently have had no important effect on structure or mineralization." They are apparently complementary to the monzonite, thus accounting for the absence of secondary effects upon the parent magma. The dikes, however, have been pyritized, and their outcrops are very ruddy; the later fracturing through the monzonite, to which is ascribed the opening of avenues for the invasion of the mineralizing agents, is also seen following the dikes, and these narrow brecciated and faulted zones, even at a considerable distance from the orebody, display epidotization, with accompanying calcite and secondary silica, both in seams and throughout the body of the adjacent rock, while sulphides of copper and larger amounts of pyrite are in evidence. Many of these subsidiary veins throughout the otherwise 'dry' monzonite area have been explored by prospect-shafts. The monzonite is generally gray and hard, in which case considerable hornblende is usually present, but in other places it weathers to coarse, rough, granular particles, and is then highly stained with iron oxide. This is particularly noticeable on the north side of Copper mountain. A short distance north-northwest from the edge of the orebody the monzonite is profoundly saussuritized, and it may be said that alteration to saussurite and epidote is characteristic over a large part of the outlying area; this is true, at least, for a distance of a mile northward from Copper mountain, and it affects the diabase dikes as well as the granodiorite. One of the surprising features of the orebody on its northern side, where a geological section can be readily traced by exposures, with the exception of about 200 ft. where obscured by 'wash', is the suddenness of the transition from mineralized to unmineralized ground. The limiting zone seems to be further defined by a more dioritic phase of the monzonite. The accompanying idealized sections, taken from Mr. Joralemon's paper, previously cited, show the chief features of the geology. The mushroom shape of the orebody is a unique characteristic, and the core of the deposit is the locus of a network of fractures, some of which reveal displacement, with slickensided walls. The nearly horizontal division between the carbonate and the sulphide ores conforms to the water-table, and the change from the oxidized ground at this level is abrupt.

Further information concerning the mineralogic character of the Ajo ore is available from a study of thin sections and polished surfaces, made by Z. K. Melcon at Stanford University under the direction of C. F. Tolman Jr. The minerals present in the ore from the sulphide zone, in the order of relative abundance, as determined by Mr. Melcon, are quartz, orthoclase, biotite, plagioclase, and magnetite. The quartz and orthoclase are prominently developed as phenocrysts, and the rock approaches more nearly the type of a granite-porphyry. Alteration has affected all the minerals, and even the quartz has not been immune. The orthoclase shows corrosion around the edges, while the body of the mass is converted into a gray substance consisting in an aggregate of minute specks that are probably kaolin. Biotite is universally altered, especially on the borders, to chlorite, magnetite, and leucoxene. The biotite was evidently unusually rich in titanium. The plagioclase was so readily attacked that only fragments remain; this mineral has chiefly suffered from calcitization, from which it may be inferred that it supplied much of the lime for the formation of the calcite. Sericite is a minor product of alteration, in places being

†*Loc. cit. supra.*

developed as well-shaped lath-like crystals, and again as minute aggregates. It replaces any of the rock-forming minerals, and is also found replacing both bornite and chalcopyrite. Secondary quartz, like the calcite, follows veinlets, and consists of small crystals occupying interstitial spaces. Bornite and chalcopyrite replace any of the other minerals, including the calcite and the secondary quartz. Preferably the sulphides replace the biotite, and even the smallest crystals of the mica show some bornite or chalcopyrite. The evidence points to the simultaneous introduction of the copper minerals. Fingers of bornite are found entering or enclosing chalcopyrite, and the reverse is equally common. Covellite is scarce, but it is seen in the unoxidized specimens closely associated with both bornite and chalcopyrite, taking the form of clusters of needles penetrating the other sulphides. It represents the only enrichment that has taken place. Chlorite is present as a persistent product of alteration from biotite, and is seen also as irregular masses.

The oxidized ores have been so deeply altered that their original constituents are no longer recognizable. The quartz is distinguishable, and to a less extent the biotite also. Limonite has resulted from the oxidation of the magnetite. The copper exists mainly in the form of malachite; next in abundance is chrysocolla; while cuprite is erratically developed, remaining to a large extent as a core in veinlets of malachite. An interesting fact revealed by the long campaign of leaching experiments is that no water-soluble copper has ever been found.

(To be continued)

Copper Production for 1917

The production of copper in 1917 was slightly less than in 1916, according to preliminary figures and estimates collected by B. S. Butler, of the U. S. Geological Survey, from all plants that make blister copper from domestic ores or that produce refined copper. At an average price of about 27 cents per pound the output for 1917 has a value of $510,000,000, as against values of $475,000,000 for 1916 and $190,000,000 for 1913.

The figures showing the smelter production from domestic ores represent the actual output of most of the companies for 11 months and the estimated output for December. The production of blister and Lake copper from domestic ores was 1,890,000,000 lb. in 1917, against 1,928,000,000 lb. in 1916 and 1,224,000,000 lb. in 1913.

The output of refined copper (electrolytic, Lake, casting, and pig) from primary sources, domestic and foreign, for 1917, is estimated at 2,362,000,000 lb., compared with 2,259,000,000 lb. for 1916 and 1,615,000,000 lb. for 1913.

According to the Bureau of Foreign and Domestic Commerce, the imports of unmanufactured copper of all forms for the first 10 months of 1917 amounted to 460,780,000 lb., as against 397,594,000 lb. for the first 10 months of 1916. The imports for the year 1916 were 462,335,000 lb. The exports of pigs, ingots, bars, plates, sheets, rods, wire, and other copper products for the first 10 months of 1917 amounted to 953,876,000 lb.; the exports for the first 10 months of 1916 were 655,473,000 lb. Similar exports for the year 1916 were 784,006,000 pounds.

At the beginning of 1917 about 128,000,000 lb. of refined copper was in stock in the United States. By adding this quantity to the refinery output of the year it will be seen that the total available supply of refined copper, exclusive of secondary copper, was about 2,490,000,000 lb. By subtracting from this quantity the exports for the first 10 months and the estimated exports for the last 2 months, and assuming no change in stocks, it will be seen that the supply available for domestic consumption in 1917 was materially less than the 1,430,000,000 lb. available in 1916.

The average monthly quoted prices of copper in 1916 and 1917 were almost exactly the same, 27.2 cents per pound. The average quoted price in 1916 was about 2.5c. more than the actual average price received. The actual price received in 1917 was probably nearer the average quoted price.

Arizona produced 687,800,000 lb., a slight decrease from the production in 1916, which was 694,800,000 pounds.

Montana produced 278,000,000 lb., as against 352,000,000 lb. in 1916.

Michigan produced 275,000,000 lb., an increase over the 269,794,000 lb. produced in 1916.

Utah produced 245,000,000 lb., as compared with 232,000,000 lb. in 1916.

Nevada produced 110,000,000 lb., an increase over the 100,800,000 lb. produced in 1916.

Alaska, with a production of about 87,500,000 lb., showed a large decrease from the previous year.

New Mexico increased its production to 104,500,000 lb. from 79,800,000 lb. in 1916.

The production of California was considerably above the 43,400,000 lb. produced in 1916.

The production in Tennessee did not differ greatly from the production in 1916, which was 14,500,000 pounds.

RESPONDING to the call to economize fuel a meeting of representative men was held at Albany, N. Y., and it was recommended that the use of stump-wood be encouraged. It was shown that the demand for such fuel had grown measurably in recent months, and that $3 worth of dynamite would break up the equivalent of eight cords of wood. Utilizing stumps helps to pay the cost of clearing 'cut-over' land, which is needed as virgin soil to increase our crops during the War.

BLEACHING-POWDER is normally produced to the extent of 500,000 tons per year. The electrolysis of common salt has been largely developed to increase the supply of this material in the United States during the War. The result is that this country will hereafter be self-supporting as to this commodity.

Explosives

By F. H. MASON

Probably never before in history has such a vast quantity of explosives been detonated at one time as that which exploded accidentally—at least, we hope so—in the ill-fated 'Mont Blanc,' in Halifax harbor, razing the north end of the city, and leaving the work of destruction to be completed by fire. The horror of the catastrophe, people in San Francisco are perhaps better able to realize than the citizens of most other cities, for many of them have been through a somewhat similar experience. A few minutes after the 'Mont Blanc' and the 'Imo' collided 400 tons of trinitro-toluene and picric acid exploded. The terrific force of the explosion laid half of a city of 50,000 inhabitants in ruins, broke windows 60 miles away, and caused people on board a ship 40 miles at sea to think they had struck a mine. Much has been written since the 'accident' about the superior explosive qualities of trinitro-toluene, whereas, as a matter of fact, its explosive force is less than that of picric acid or trinitro-cellulose or some other nitro-explosives, but it has been selected in preference to them on account of its more stable qualities. When toluene is treated with nitric acid three nitro-derivatives can be produced; successive hydrogen atoms being replaced by nitrous acid, thus:

$$C_7H_8 + HNO_3 = C_7H_7NO_2 + H_2O$$
$$C_7H_8 + 2HNO_3 = C_7H_6(NO_2)_2 + H_2O$$
$$C_7H_8 + 3HNO_3 = C_7H_5(NO_2)_3 + 3H_2O$$

Trinitro-toluene is a yellow crystalline powder, melting at 79°C. When detonated with a fulminative cap it explodes with great violence and gives off dense black fume, whence the name 'black Maria' and 'coal box' that the soldiers have given to explosive shells charged with it. The products of combustion are, besides carbonic acid and nitrogen, carbon monoxide, free carbon, and hydrogen. Trinitro-toluene is often mixed with an oxidizing agent, generally ammonium nitrate, and sometimes aluminum dust, and small quantities of carbon are added. Trinitro-glycerine $C_3H_5(NO_3)_3$, on the other hand, is a self-contained explosive, that is, it contains more than enough oxygen for the complete combustion of its other ingredients; the products of the explosion are carbonic acid, nitrogen, and water, together with 4% of free oxygen.

When phenol, or carbolic acid, is mixed with an equal weight of sulphuric acid and the mixture is gradually added to three times its weight of nitric acid, trinitrophenol or picric acid is produced. It is a lemon-yellow crystalline substance melting at 122.5°C. It was employed extensively under the names of lyddite and melinite for charging shells used in the South African war, but was found to be untrustworthy, sometimes exploding prematurely, and at other times not at all. Cordite is one of the most trustworthy explosives. It is made by mixing trinitro-glycerine and trinitro-cellulose together and dissolving them in acetone or some other common solvent. Five per cent of vaseline is added to increase the stability, and to lubricate the gun. When gelatinization is complete the substance is pressed through a die of the desired size, and the resulting 'cord' is wound on a reel and allowed to dry until the last trace of acetone has evaporated. In the case of thick cords, the drying operation sometimes takes as long as two months. Such accuracy is obtained in the manufacture of cordite that the plus or minus velocity is only 40 ft. in the prescribed velocity for rifles of 2380 ft. per second, according to the British regulations. Probably the most powerful explosive known is tetranitro-aniline and tetranitro-methyleaniline. The latter, under the less formidable name of 'tetryl,' is sometimes used as a substitute for fulminate of mercury in detonators. Recently, too, lead hydrazoate or triazide, PbN_8, has been employed for the same purpose.

Copper and Aluminum

The following data, prepared for the British Aluminum Co., are not generally accessible and may be useful to those having electrical and other problems to solve.

Property	Copper	Aluminum
Position in electro-chemical series	24	10
Melting point, deg. C	1100	655
Melting point, deg. F	2010	1210
Specific heat (water = 1)	0.094	0.212
Thermal conductivity (silver = 100)	73.6	31.3
Electric conductivity (silver = 100)	97.5	59.5
Co-efficient of linear expansion per deg. C	0.0000167	0.0000234
Specific gravity, rolled or drawn	8.89	2.71
Tensile strength in lb. per sq. in.	560,000–63,000	26,000–33,000
Tensile strength in kg. per sq. mm.	28–42	17–23
Ratio of tensile strength to weight (equal area)	1	1.62
Ratio of tensile strength (equal conductance)	1	2.65
Ratio of tensile strength (equal temp. rise)	1	2.12
Elastic limit of % of tensile strength	75	70
Modulus of elasticity in lb. per sq. in.	16,000,000	9,800,000
Modulus of elasticity in kg. per sq. mm.	11,200	6,905
Specific resistance in microhms per cu. cm. at 60° F. (15.5°) soft	1.690	2.770
Specific resistance in microhms per cu. cm. at 60° F. (15.5°) hard	1.725	2.870
Specific resistance in microhms per cu. cm. at 0° C. (32° F.) soft	1.595	2.610
Specific resistance in microhms per cu. cm. at 0° C. (32° F.) hard	1.650	2.70
Resistance of conductor 1000 yd. long, by 1 sq. in. cross-section, soft	0.02398	0.03932
Resistance of conductor 1000 yd. long, by 1 sq. in. cross-section, hard	0.02443	0.04070
Co-efficient of increase of resistance with temperature per deg. C	0.0038–0.0043	0.0032–0.00400
Co-efficient of increase of resistance with temperature per deg. F	0.0021–0.0024	0.0018–0.0022
Weight per 1000 yd. by 1 sq. in. nominal section (lb.)	11,700	3,520
Ratio of conductivities for equal area	1.0	0.61
Ratio of areas for equal resistance	1.0	1.64
Ratio of diameters for equal resistance	1.0	1.28
Ratio of weights for equal area	3.3	1.0
Ratio of weights for equal resistance	2.0	1.0

Picric acid is obtainable from the gum-resins secreted by certain plants. Thus, acaroid, black-boy, botany-bay, and grass-tree gums, yield picric acid upon treatment with nitric acid. This fact has not been utilized hitherto in a commercial way on account of the violence of the reaction, and the difficulty of controlling it, so as to secure a satisfactory output. Miller and Irlam have overcome this difficulty by treating the purified gum with limited amounts of acid, in the cold, or at temperatures not exceeding 40° C. Picric acid, nitro-phenol, and dinitro-phenol are obtained by altering the quantity and temperature.



VIEWS IN NORTHERN IDAHO

Mining Districts of Northern Idaho

By E. K. SOPER

INTRODUCTORY. There are 150 mining districts in Idaho, but more than 90% of its metal production comes from the Coeur d'Alene region in Shoshone county in the northern part of the State. Northern Idaho, sometimes called the 'pan-handle,' embraces an area covering four counties: Boundary, Bonner, Shoshone, and Kootenai. Each of these counties contains ore deposits of importance, but until recently there has been little development outside of the well-established Coeur d'Alene region. However, within the past two or three years, prospecting and development operations have been extended to outlying districts in the Coeur d'Alene as well as to the northern counties generally, with the result that some promising mines and prospects have been opened.

TOPOGRAPHY. Northern Idaho is a region of steep-sided heavily-forested mountains, dissected by numerous deep-stream valleys. Several large lakes of glacial origin occur in the region, the most important being Lake Coeur d'Alene, Lake Pend Oreille, and Priest Lake. The main streams have eroded their channels to the approximate level of the Spokane valley. The elevations are not high as compared with those attained by the mountains farther east and south. The maximum relief is about 4000 ft., which also represents the topographic range of the outcrops of the veins. The surface, except on the steep slopes, is usually deeply weathered, and this, taken in conjunction with the heavy covering of vegetation, makes prospecting difficult over much of the area.

GEOLOGY. The principal formations of northern Idaho consist of Algonkian sediments comprising quartzite, argillite, and slate, with some thin layers of interbedded limestone. These rocks, known as the Belt Series, with schists that probably represent their metamorphic equivalents, outcrop over a large part of northern Idaho and extend into Montana and British Columbia. The remaining part of the area consists chiefly of granite, probably of Cretaceous age, with associated gneisses and schists. Some of these gneisses may be of Archean age, since isolated areas of Archean gneiss are known to outcrop in numerous localities farther south. The granite is of the monzonite variety and outcrops over large areas in all four of the counties mentioned. It also occurs in smaller areas intruding the sediments of the Belt Series at many localities and probably underlies the sedimentary and metamorphic rocks throughout the entire region.

In addition to the granitic intrusives, the sedimentary rocks are cut by numerous basic dikes. These dike-rocks consist mostly of diabase or lamprophyre; they are associated with the ore deposits in nearly all of the mining districts in northern Idaho. There are no Paleozoic sediments in the northern end of the State, but in central and southern Idaho the Paleozoic rocks contain many important ore deposits. The only other formation, exclusive of glacial drift and Quaternary sand and gravel, that outcrops in this region is a patch of Tertiary lava, in the south-west corner of Kootenai county, where it represents the north end (in Idaho) of the great Columbia lava flow. This flow, or succession of flows, extends southward along the valley of the Snake river and covers the plains of eastern Washington and Oregon, as well as western and southern Idaho.

ORE DEPOSITS. The ores found in the four counties forming the 'pan-handle' include lead-silver, lead-zinc-silver, zinc, copper, gold, tungsten, and molybdenum ores, besides gold placers. The most important deposits

are the lead-silver, lead-zinc-silver, and zinc ores of the Coeur d'Alene. Most of the deposits and mines of the Coeur d'Alene have been described in detail by Ransome and Caulkins,[1] Hershey,[2] Umpleby,[3] Bell,[4] and others, and these descriptions need not be repeated here. However, there have been some recent dvelopments in the Couer d'Alene as well as elsewhere in northern Idaho that may be of more timely interest.

Shoshone County

The most important mining districts are the following: Wallace (Placer Center), Mullen (Hunter), Burke (LaLande), Kellogg-Wardner (Yreka), Evolution, Pine Creek, Slate Creek, Shoshone, Beaver, East Coeur d'Alene, Murray, and Bald Mountain (Monitor). The most important of these districts from the standpoint of production are the Wallace (Placer Center), Mullan (Hunter), Burke (LaLande), Kellogg-Wardner(Yreka), Pine Creek, and Beaver. Coeur d'Alene is a name frequently used to designate the region comprising all of these districts.

The Wallace district contains important deposits of both lead and zinc ores. The district embraces mines on Nine-mile creek from Wallace to Sunset, and the surrounding territory. The deposits within this area include some very complex ores. With the exception of the clean sphalerite ore of the Interstate-Callahan deposit, the ores usually consist of intimate mixtures of galena and sphalerite, with more or less pyrite, magnetite, and siderite. The galena always carries silver, but there is very little, if any, silver associated with the sphalerite. In some of the mines ore-shoots of comparatively clean galena are found, and in the Interstate-Callahan mine the ore consists of sphalerite, free from the sulphide minerals so common in the other deposits of the district. Where galena and sphalerite occur together, the two minerals are often in such close association that the finest grinding is required to break the association. The association is rendered still more refractory in some mines by the addition of pyrite, and by the presence of much siderite in the gangue. The principal mines of the Wallace district include the Interstate-Callahan, Tamarack and Custer, Rex, and Success. All of these supply large mills, and since the introduction of flotation the recoveries have been greatly increased.

The Mullan (Hunter) district includes the town of Mullan, about seven or eight miles east of Wallace, on the branch of the Northern Pacific railroad connecting Wallace with Missoula, in Montana. The ores of this district contain less zinc than those in the Wallace district. Lead-silver ore is the principal product, and the district contains some of the most important lead-silver mines in the Coeur d'Alene region. There is also an important copper mine, the National, which is now under active development. The famous Snowstorm copper mine, now worked out, was also near Mullan. The principal active mines are the Morning, Gold Hunter, and National. An important property still in the development stage is the Star, now engaged in litigation with the Morning mine of the Federal Mining & Smelting Co. The Morning ore contains considerable sphalerite associated with the galena in a heavy gangue of siderite. Some barite and quartz is also present, and pyrite and pyrrhotite also occur associated with the lead and zinc sulphides. The silver is associated with the galena. Considerable quantities of oxidized lead-silver ore were found in the old upper levels of the Morning mine, and it has been reported recently that additional bodies of lead carbonate have been found in developing new ground on the upper levels. Because of the association of considerable zinc sulphide with the argentiferous galena in the Morning and Gold Hunter ores, and because of the presence of large amounts of siderite in the gangue, these ores have presented serious milling difficulties, now successfully overcome. The mines in the Mullan district were among the first to employ selective flotation.

The mines in the Burke (LaLande) district are nearly all situated along Canyon creek in the Burke canyon, which joins the south fork of the Coeur d'Alene river at the town of Wallace. The ore deposits occur at intervals along the canyon between Wallace and Burke, the most important being at Burke, which town is well known from the fact that the famous Hercules and Hecla mines are there. The deposits consist of replacement veins occupying fault-fissures in Burke quartzite, and in their main geological features are similar to the type prevailing throughout the Coeur d'Alene region. The ore consists chiefly of argentiferous galena, comparatively free from zinc sulphide. Recently, however, some ore consisting of a mixture of sphalerite and galena was found in the Oronogo vein of the Hecla mine. This lead-zinc ore is now being milled separately, so as not to mix with the clean lead-silver ore which constitutes the bulk of the output of the Hecla. The Hercules ore has always been noted for being exceptionally high in lead and silver and remarkably free from zinc. Some of the richest stopes ever opened in the Coeur d'Alene are being worked in the Hercules mine, and although the property has been developed to considerable depth, very little zinc sulphide has yet been encountered. In addition to the Hercules and Hecla mines, the Burke district also includes the Green Hill-Cleveland, Frisco, Marsh, Blackbear, Gertie, Oom Paul, and other properties.

The Kellogg-Wardner (Yreka) district embraces the

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[1]Ransome, F. L., and Caulkins, F. C. 'The Geology and Ore Deposits of the Coeur d'Alene District, Idaho," U. S. G. S. Prof. Paper 62, 1908.

[2]Hershey, Oscar H. 'Genesis of Lead-Silver Ores in Wardner District, Idaho;' M. & S. P., June 1, 8, 15, 1912.

'Origin of Lead, Zinc, and Silver in the Coeur d'Alene;' M. & S. P., Sept. 27, Oct. 4, 1913.

'Origin and Distribution of Ore in the Coeur d'Alene;' Pamphlet, M. & S. P., San Francisco.

[3]Umpleby, J. B. 'Genesis of Success Zinc-Lead Deposit;' 'Economic Geology,' Feb.-March, 1917.

[4]Bell, Robt. N. Annual Reports of State Mine Inspector, Boise, Idaho.

region surrounding the towns of these names, and includes the famous Bunker Hill & Sullivan mine. The ore is chiefly argentiferous galena, very little zinc having as yet been found in any of the mines of this district. Like most of the other deposits of the Coeur d'Alene, these consist of metasomatic veins in pre-Cambrian sediments along fault-fissures. Some of the deposits contained rich oxidized silver-lead ore near the surface. The Bunker Hill & Sullivan vein is said to be the one vein in the Coeur d'Alene that showed a prominent outcrop. The ores of this district are less complex and easier to mill than most of those in the Coeur d'Alene. During the summer of 1917, the Bunker Hill & Sullivan company completed its new lead smelter, at which custom work will also be done, at Bradley, near Kellogg. Suit has been brought by the A. S. & R. Co. to prevent the Bunker Hill company from smelting its ore. The existence of a custom lead smelter in the heart of the Coeur d'Alene will be of special benefit to the operators of small mines. Some years ago one of the most productive veins in the Kellogg-Wardner district was lost at a fault intersection, and all subsequent attempts to recover the faulted segment of the vein have failed. Recently operations have been started to explore the ground under and adjacent to the town of Wardner in an attempt to find a continuation of this vein, and of other rich ore deposits formerly worked in the vicinity. The principal mines of the district are the Bunker Hill & Sullivan, Caledonia, Stewart, and Last Chance. The Sierra Nevada and the Alhambra have recently reached the producing stage.

The Pine Creek district is new and important. The district embraces the region included within the drainage basin of Pine creek and its tributaries, a distance of 12 to 15 miles. A branch line of the O. W. R. & N. is now being constructed up Pine creek. The ore deposits are replacement veins occupying fault-fissures or shear-zones in the Prichard slate. The veins are associated with basic dikes. While they resemble the other veins of the Coeur d'Alene in their broader geologic relations, they differ from the lead-silver veins in many respects, as, for instance, in the general occurrence of a fine-grained intimate mixture of sphalerite, galena, and pyrite in the typical ore; the fact that the ore deposits are confined to the Prichard slate; the frequent absence of well-defined walls; and the more frequent occurrence of the ore in shear-zones. The principal mines of the district are the Constitution, Highland-Surprise, Hypotheek, Nabob, Douglas, Northern Light, and Amy Matchless groups. Most of these properties have been making regular shipments for some time in spite of the handicap of a long wagon-haul over bad roads to the present shipping point on the Wallace branch of the O. W. R. & N., the nearest point of which is at the mouth of Pine creek. In addition to the lead-zinc-silver ores just mentioned, this district contains two productive antimony properties, the Star Antimony and the Coeur d'Alene Antimony mines. It is only within the last year or two that this district has come into prominence as a producer, although the presence of veins in this locality has long been known. During the past year the Anaconda Mining Co. has been purchasing local ores for treatment at its Great Falls plant. The district owes much of its present activity and bright future to the fact that its complex ores have found a market.

The Beaver district likewise has only recently reached the production stage. It has been known for some time that ore deposits existed on Beaver and Carbon creeks and their tributaries, but owing to the complexity of these ores, and the absence of a market for the impure



concentrate, the deposits have remained undeveloped. Recently the introduction of flotation and the general improvements made in milling ores of this type, together with the construction of a custom zinc plant by the Anaconda company to treat impure zinc concentrate, have made it possible to exploit these ores at a profit. This district may be most easily reached from the Murray branch of the O. W. R. & N. During the year a branch line of the O. W. R. & N. has been completed up Beaver creek to Carbon station. A spur of the railroad has been extended to the Ray-Jefferson mill. The ore deposits are similar to those of Pine creek. The veins have been formed partly by replacement of the sheared slate, and partly by fissure-filling. It is difficult to determine the true walls of the veins because of several parallel slip-planes, which are frequently accompanied by much

gouge. The ore occurs as seams, bands, and lenses in the sheared slate. The ore contains sphalerite with a subordinate amount of argentiferous galena, with which is associated much pyrite, and sometimes a little gold. The typical ore is an intimate mixture of the sulphides, requiring extremely fine grinding. The principal mines are the Ray-Jefferson, Idora, Tuscumbia, and Red Monarch.

The Evolution district includes the Big Creek watershed and some territory on the north side of the south fork of the Coeur d'Alene river. The district lies halfway between Osborn and Kellogg on the O. W. R. & N. The principal prospects are the Polaris, Yankee Girl, Yankee Boy, Western Star, Trojan, Silverado, and Rhode Island. Considerable exploration and development work is under way, but as yet no important producing mines have been developed.

The Shoshone district, which lies 10 miles south-west of Paragon and 5 miles east of Murray, is reached by the Murray branch of the O. W. R. & N. through Enaville. The principal mines and prospects are the Terrible Edith, Monarch, Paragon, Black Horse, Bear Top, and Orofino. Development work has been under way at most of these properties during 1916-1917, and considerable ore has been shipped from the district in the past.

The Slate Creek district, which lies 15 miles south of Wallace, is one of the most inaccessible in the Coeur d'Alene. It is reached by trail from Wallace. The geology is similar to that prevailing throughout the Coeur d'Alene. The sediments are intensely folded, and faulting is in great evidence. Intrusives are numerous. At the present time there are no producing properties in this district, but there are many prospects and considerable development work is being done.

The East Coeur d'Alene district lies on the outskirts of the Coeur d'Alene region. It is reached from St. Joe on the Chicago, Milwaukee & St. Paul railroad. The ore deposits consist of veins in brecciated zones along fissures in Algonkian sediments, chiefly quartzite. Copper ores predominate, the chief minerals being bornite and chalcopyrite. The deposits generally have heavy gossans. The Black Prince is probably the best known of the properties in this district.

The Bald Mountain (Monitor, St. Regis) district is outside the area usually included within the Coeur d'Alene region. It lies in the Bitterroot mountains and extends into Montana. The district is reached from Saltese, Montana, or from Lookout, both stations on the Northern Pacific railroad. The Chicago, Milwaukee & St. Paul railroad also touches this district. The ore deposits, which are veins along fault-fissures, are valuable for copper. The ores carry about 0.02 oz. gold to 1% of copper. The principal mineral is chalcopyrite. The most important mines are the Richmond, Monitor, and Bald Mountain. Other properties are the Buffalo, Park, Springfield, Champion, Eagle, Bullion, North Star, Alpino, and Leroy. The mineral deposits lie in a belt along both the eastern and western slopes of the Bitterroot divide, which forms the Montana-Idaho boundary. The Richmond is now being worked and has recently attracted considerable attention. Several of the other properties in the district were actively developed during the past summer.

The Murray district is the oldest in the Coeur d'Alene and has been known chiefly for its production of gold. It includes the ground surrounding the town of Murray on the north fork of the Coeur d'Alene river, and is reached through Enaville by a branch of the O. W. R. & N. The country-rock consists of pre-Cambrian sediments cut by intrusives. The chief ore deposits are veins in Prichard slate. The erosion of the gold-bearing veins has resulted in the formation of numerous placer deposits, and it was these gold placers that first attracted the attention of prospectors to the Coeur d'Alene. During recent years there has been very little activity in the Murray district. The placers have been largely worked out and the remaining gold ores have proved too low-grade. During the past year the old Golden Chest mine was re-opened in an attempt to mine the ore remaining on the lower levels. The effort proved unsuccessful so far as the gold was concerned, but a considerable quantity of rich tungsten ore, consisting of scheelite in quartz, was found in cross-fissures associated with the main vein of auriferous pyrite. A considerable quantity of tungsten ore was also found broken in the old stopes. This ore was concentrated and shipped, but the scheelite proved to be pockety and the mine has again become idle. During the past summer, following extensive explorations by churn-drilling, the Yukon Gold company has begun the construction of a large dredge to work the gravel of some of the tributaries of the North fork. The construction of this dredge is now well under way. The preliminary drilling is said to have demonstrated the existence of a large area of gold-bearing gravel. The Empire copper mine on the Little North fork of the Coeur d'Alene river, near Enaville and west of the Kellogg-Wardner district, has been a continuous producer during the past year. This mine was equipped with a 150-ton mill, which, according to reports, has recently been enlarged. The vein is opened by three adits and long ore-shoots have been exposed on several levels. The ore is said to carry 3 to 5% copper.

With respect to the Coeur d'Alene region as a whole, it may be said, in summary, that the developments for the past two years have been highly satisfactory. While some of the big rich ore-shoots that have supplied so much of the past production are rapidly aproaching exhaustion, new orebodies are being developed to take their place, although some of these ores are more refractory. Not only have there been important new discoveries of zinc ore, but some of the biggest and richest bodies of galena ever known in the Coeur d'Alene are being mined at the present time. The great importance of the Prichard slate as an ore-bearing horizon has been demonstrated beyond doubt, and while the ores found in this formation are usually complex and low-grade, they will doubtless insure a considerable extension to the productive life of the region.

Kootenai County

There are only three mining districts in this county, and none of these are important producers at this time.

The Medimont district, reached from Medimont station on the Wallace branch of the O. W. R. & N., contains silver-lead ores in veins in Algonkian sediments. None of these deposits have been developed to any extent and little information is available concerning the prospects.

The Camas Cove district in the south-eastern corner of the county produces a little placer gold. The most important enterprise is that of the Tyson Consolidated company. This company has expended considerable capital in equipping a hydraulic mine.

The Lakeview district in the extreme north-east corner of the county comprises a small area around the south shore of Lake Pend Oreille. Only the extreme south end of the district lies in Kootenai county. The Lakeview district lies chiefly in Bonner county.

Bonner County

The Lakeview district lies along the south-east shore of Lake Pend Oreille and is reached from Sandpoint at the north end of the lake, or from Bayview from the south end, by boat to Lakeview landing. Both Sandpoint and Bayview may be reached by railroad from Spokane. As yet there is no railroad tapping the district. The principal geological formation outcropping in the district is the Newland. This is probably the equivalent of the Wallace formation of the Coeur d'Alene. It consists chiefly of slates but contains some quartzites and a little limestone. Acidic intrusives (chiefly monzonite) occur within a few miles of the ore deposits. The sedimentary formations are cut by numerous faults. The ore deposits consist chiefly of veins in the sedimentary rocks. They are associated with narrow basic dikes. The ore contains lead and silver with zinc. The zone of oxidation is shallow. Typical ore consists of a complex mixture of argentiferous galena, sphalerite, and pyrite. The pyrite carries a little gold and silver. Some copper sulphides, chiefly chalcopyrite, also occur associated with the lead and zinc sulphides. The principal mines are the Webber, Keep Cool, Venezuela, Conjecture, Rainbow, Spider, Silver Cord, and Swastika. During the past year some high-grade hand-sorted ore was shipped from the Venezuela, and development work was carried on at several other properties. None of the mines operate mills. The Webber mine formerly had a mill, but it was never operated successfully. This mill, which has been idle for years, burned down last summer. The district contains some strong veins carrying considerable milling ore in addition to the first-class ore that has been taken from the upper levels. Most of the properties have not been developed more than a few hundred feet below the surface. It is probable that systematic development would result in opening up important bodies of ore of milling grade, and were it not for the lack of transportation facilities, this district would probably be an important producer at the present time.

The Blacktail (Pend Oreille) district includes Blacktail mountain and the surrounding area on the western shore of Lake Pend Oreille, and may be reached either by boat from Bayview and Sandpoint, or by a wagon-road from Sagel station on the Northern Pacific railroad, five miles north-west of Blacktail. The general geology of the district is similar to that of Lakeview on the opposite shore of the lake. The ore deposits consist of veins occupying fault-fissures in sedimentary rocks. Although there are a number of important prospects in the district, the Armstead mine is the only important property at the present time. The Armstead shows a clean-cut vein from three to four feet wide and occupying a fault-fissure in quartzite and slate. The vein strikes north and south; dips 43° east, and cuts the bedding of the sedimentary rocks at a small angle. The ore consists of a mixture of galena, tetrahedrite, and argentite, with some chalcopyrite and native silver, in a quartz-siderite gangue. Many inclusions of country-rock occur within the vein. This property, which was formerly known as the Keystone mine, was recently taken over by Henry H. Armstead, and consolidated with a large group of adjoining mining claims. It is being developed in a systematic and thorough manner. Already large bodies of ore have been exposed and at least 70,000 tons of lead-silver ore are reported blocked out on the upper levels, which, in addition to the lead and zinc content, is said to contain from 30 to 50 oz. of silver and 0.16 oz. gold per ton. The company intends to build a modern concentrating mill as soon as the mine has reached the desired state of development. During the late summer and fall some records in fast driving were made at this property while advancing the lower adit, which is to serve as the main working-level. In 31 days from the end of November the adit was advanced 544.8 ft. This lower adit, which is already in 2858 ft., is being driven to intersect the main vein, which it is expected will be cut 542 ft. beyond the present face. The adit will probably be extended a considerable distance beyond this point to cut other parallel veins known to exist. The total depth to be obtained on the Armstead vein by this adit will be about 1600 ft. and an additional 500 ft. of depth can be obtained by driving a lower adit slightly above the level of the lake. The results of these operations are being watched with keen interest by all those interested in the Blacktail and surrounding districts, since this is the first attempt at deep development to be made on any of the properties in northern Idaho outside the Coeur d'Alene region.

The Clark Fork district includes the region surrounding Clark Fork station on the Northern Pacific railroad near the point where the Clark Fork river joins Lake Pend Oreille. The district extends back for several miles on both sides of the river, and includes a large number of prospects. Most of the properties, however, are on the north side of the Clark Fork. The ore deposits consist of veins in slate and quartzite and in their general relations are similar to those of the Coeur d'Alene. The ores consist mostly of argentiferous galena in a quartz-siderite gangue. There are also several deposits of cop-

per ore carrying chalcopyrite as the dominant ore-mineral. The principal mines and prospects include the Lawrence, Copper Giant, Clarinda, Hidden Treasure Group, and Lucky Strike. The Lawrence mine, which is reached by good wagon-road 1½ miles east of Clark Fork, is being operated on a small scale. The mine, which has been only slightly developed, contains a vein of argentiferous galena in a ripple-marked quartzitic slate. The property is equipped with a 50-ton mill, and is making a high-grade lead concentrate containing from 11 to 15 oz. silver per ton. None of the other properties in the district has been developed beyond the prospect stage. The Lawrence is the only mine at which a mill has been erected. Some of these prospects, however, exhibit excellent surface showings. At the Copper Giant mine, 3½ miles west of Clark Fork, a 3-ft. vein showing chalcopyrite, bornite, and cuprite in a quartz-siderite gangue has been exposed in several short adits. At the Clarinda mine, which adjoins the Copper Giant, a similar vein has been opened. However, at this property the copper mineralization near the surface gave place to argentiferous galena at a shallow depth.

The Hope district adjoins the Clark Fork on the north-west and includes the country on the north-east shore of Lake Pend Oreille in the vicinity of the town of Hope, on the Northern Pacific railroad. The geology is similar to that of Clark Fork. Granitic intrusives are prominent in the vicinity of Trestle creek near Hope. The principal properties are the Marguerite, El Paso, Rebecca, Black Bear, Big Five, Park River Mining Co., and the Morning Star. All of these except the Morning Star are in the drainage basin of Trestle creek. None of them is beyond the prospect stage. The deposits include ores of lead, silver, copper, and gold, and some of the more promising veins are under active development during the past summer.

The Priest Lake district includes the region surrounding Priest lake in the extreme north-west portion of Bonner county. The principal settlement is Coolin, on the south shore of Priest lake, 25 miles north of Priest River station on the Great Northern railroad. The district is reached by wagon-road from Priest River. The ore deposits consist of veins in pre-Cambrian sediments associated in places with granite. The area of the district is large and the geology is imperfectly known. There are no producing mines at the present time, although several promising prospects are being developed. In addition to these prospects a large number of claims have been staked and upon these annual assessment work is being done. The deposits consist chiefly of lead-silver ores, but copper-bearing veins carrying some gold also occur in the district.

Boundary County

The Porthill district is in the extreme north-west corner of Idaho, along the British Columbian boundary. It is reached from Porthill, Idaho, a station on a branch of the Great Northern railroad. The geological formations consist of pre-Cambrian sediments associated with granite and granite-porphyry intrusives. Basic dikes also cut the sediments. Quartzite, which resembles the Burke quartzite of the Coeur d'Alene, is the typical country-rock in the vicinity of the Idaho-Continental mine. The ore deposits occur as replacement veins in the sedimentary rocks associated with diabase dikes, and in many respects resemble veins of the Coeur d'Alene. The Idaho Continental mine, operated by A. Klockmann, is the most important mine in the district and ranks as one of the chief producers in Idaho outside the Coeur d'Alene. The property is reached by an excellent auto-truck road, 26 miles long, constructed by the Idaho-Continental Mining Co. at a total cost of $130,000 in order to deliver concentrate and ore to the railroad at Porthill, which is the nearest shipping point. The ore deposit of the Idaho-Continental mine consists of a sheeted zone 10 to 20 ft. wide in quartzite. The shattered quartzite is replaced by silver-bearing galena, which occurs as numerous stringers and seams alternating with bands of partly replaced quartzite. Some quartz filling was noted especially in the upper levels, but the deposit is essentially of the replacement type. The ore consists of argentiferous galena, which carries about ½ oz. silver per unit of lead. Large amounts of pyrite are associated with the galena. The ore is practically free from sphalerite and the concentrate contains only about 2% zinc. A little chalcopyrite is associated with the galena and pyrite, but not in commercial quantity. The mine has recently constructed a new mill of 150-ton daily capacity to take the place of the mill that was burned down not long ago. The mill is equipped with the necessary crushing machinery, picking belt, jigs, and tables. The company intends to add a flotation plant. The mill-ore averages from 10 to 12% lead. Considerable first-class ore carrying 50% lead and 20 to 25 oz. silver per ton is shipped direct. The ratio of concentration is about 8.6:1. The concentrate is transported to Porthill by auto-truck, and during the past summer and fall, eight or nine trucks were kept in continuous operation. Because of the fact that the concentrate is high in lead and iron and relatively free from zinc, it is in demand at the smelters. There are several promising prospects in the region surrounding the Idaho-Continental property, but little development work has been done on any of them. The area included in the district is large, and has been thoroughly prospected. In addition to the prospects west of Porthill, in the vicinity of the Idaho-Continental mine, there are other properties in the district upon which some development work is being done. Among these may be mentioned the Golden Sceptre (copper-silver) near Porthill; the North Star group (lead-silver) near Porthill; the American Girl group (molybdenum); the Blanche group (gold, silver, lead); Dora group (tungsten); and the Rosie D., all near Copeland.

The Moyie Yaak district is about 19 miles north-east of Bonners Ferry and may best be reached from that point. The ore deposits occur as veins and sheeted zones in pre-Cambrian sediments of the Belt series associated

with intrusives. The ores are valuable for lead, silver, and gold. The district contains a number of prospects and small mines upon which some development work has been done. In addition, there are many others on which only assessment work is being done. There are as yet no important producing mines in the district, but this is probably due to its isolation and the lack of transportation facilities. The country has been only superficially prospected and offers excellent opportunities for discovery. A branch of the Canadian Pacific railroad passes through this district, and if good wagon-roads were available, it would not be difficult to secure a shipping point for the ores. The best known property is probably the Buckhorn mine, situated in the rugged mountains along the Moyie river, and about 10 miles north of Kootenai river. A wagon-road connects this mine with the main road along the Kootenai. This property, at which more than 2000 ft. underground work has been done, is equipped with a 5-stamp mill, and is producing lead-silver ore that carries some gold. Other properties in the district include the Copper Falls, 2½ miles east of Eastport; Moyie Gold-Copper Mining & Milling Co.; and the Moyie hydraulic mine.

The Katka-Leonia district is east and a little south of Bonners Ferry along the main line of the Great Northern railroad in the vicinity of Katka and Leonia stations. The district may be reached from either of these stations or by wagon-road from Bonners Ferry. The Katka silver-lead mine and Idaho-Montana mine (also a silver-lead deposit) both near Katka station, have done some development work recently and have produced some ore. Near Leonia, the Idaho Gold & Ruby Mining Co. is erecting a plant for hydraulic operations on a deposit of gold-bearing gravels. Another property at which some development work has been done recently is that of the Idaho Copper Mining Co., also near Leonia. The mountains throughout this area contain abundant evidence of mineralization, but prospecting is rendered difficult by the heavy covering of vegetation. Numerous prospects have been located in addition to those just named, but at most of these only assessment work is being done. The whole region included within Boundary county shows evidence of mineralization, and numerous veins outcrop. The country is exceedingly mountainous and the canyon slopes are steep and heavily forested. This condition, in conjunction with the inaccessibility of much of the area, has made prospecting difficult and has retarded development. However, the region is one of promise, and it is not unlikely that several producing mines may be developed here within the next few years.

THE VALUE of the mineral production of Alaska in 1917 is estimated at $41,760,000, exceeding that of any previous year except 1916, which was $48,632,000. The decrease in 1917 was therefore about $6,870,000. During 33 years Alaska has produced over $391,000,000 worth of gold, silver, copper, and other minerals. Of this amount $293,000,000 represents the value of the gold, and $88,200,000 that of the copper.

Antimony in Humboldt County, Nevada

Antimony is one of the necessary war minerals for which the United States is dependent on foreign countries. In view of the desirability of having information on all possible domestic sources of antimony, the Arabia mining district, in Humboldt county, Nevada, has recently been examined by a geologist of the U. S. Geological Survey. This mining district, long idle after its first period of activity in the late 'sixties, has become active again. The pioneer smelter in Nevada, at Oreana, on the Central Pacific railroad, was built in 1865 to reduce the ore of the Montezuma mine in the Arabia district. The ores are notable in that they consist almost wholly of silver-bearing bindheimite, the so-called hydrous antimonate of lead. None of the orebodies has been explored to a vertical depth greater than 200 ft., and the zone of unaltered sulphides has nowhere been reached. The primary ores were formed under high temperatures by 'deep-seated' mineralization. In view of this origin, some of the stronger veins may carry ore in depth. This possibility, together with the change that a lower zone of enriched silver sulphides exists, suggests that the district merits deeper exploration than has yet been attempted. The principal use of antimony in war is to harden the lead in bullets.

TESTS to determine the influence of small amounts of copper in steel have recently been reported by Carle R. Hayward and A. B. Johnston, in the bulletin of the American Institute of Mining Engineers. They confirm the findings of previous investigators, as follows: E. J. Ball states that copper increases the tensile strength and hardness but lowers the elongation; J. E. Stead states that copper-steels closely resemble nickel-steels containing equivalent percentages of nickel as regards tensile strength, resistance to shock, corrosion, and hardness; F. H. Wigham found that copper in small amounts had no injurious effects on steel; P. Breuil found that, with 1% carbon, copper lessened the brittleness of steel, and in low-carbon steel it increased the tensile strength and lowered the ductility slightly; and H. H. Campbell states that copper up to 0.25% slightly raises the elastic limit, elongation, and reduction of area.

BUYERS of zinc concentrates for the smelting companies, as stated by H. G. George, in a contribution to the A. I. M. E., purchase on a base of 60% metallic zinc in the concentrates. They penalize $1 per unit of zinc below 60% and they pay a premium of $1 per unit of zinc above 60%. Iron is penalized at the rate of $1 per unit over 1%, lime is penalized 50c. per unit over 2%, and lead is penalized $1 per unit over 1%. This scale of penalties and premiums usually applies to concentrates containing from 50 to 63% metallic zinc. For ores of a lower grade a different scale is used. Some ores are purchased on contract deducting a fixed smelting charge from the value of the metallic zinc content of the concentrates.

Pressure in the Formation of Ore Deposits

By STEPHEN TABER

As early as 1836 Weissenbach[1] assumed the existence of a 'force of crystallization' in order to explain the peculiar occurrence of certain crystals of pyrite and arsenopyrite. Later, Lavalle[2] noticed that a crystal growing on the bottom of a glass dish may raise itself because of the addition of new material to its supporting edges. This observation opened a wide field for investigation, but unfortunately it was almost entirely neglected for many years. Even today few geologists recognize the importance of the fact that crystals may grow in directions in which growth is opposed by adjacent solid bodies. During the last four years I have been conducting a series of experiments with the two-fold purpose of determining the conditions under which growing crystals may exert pressure against other solid bodies, and of producing veins in the laboratory where the origin and development of their structural features could be observed in detail. Most of these experiments have already been described;[3] therefore only a brief summary of some of the results and conclusions is necessary in this place. A number of salts have been used, their precipitation being brought about by cooling, by evaporation, and by the mingling of two solutions differing in composition; glass containers have been broken during crystal-growth, and nearly all of the vein structures found in nature have been successfully duplicated.

There is really nothing remarkable in the growth of a crystal under external pressure; all crystals have been formed under some degree of pressure, and it is obviously impossible to grow crystals in a vacuum. When the material for crystal-growth is obtained from a solution, the crystal will continue to grow as long as its surfaces are in contact with the super-saturated solution. If any portion of the surface of a crystal is not in contact with solution, or if the solution is not super-saturated with respect to that surface, no addition of new material to that portion of the crystal will be made, although the crystal may develop in other directions. Concentration of the solution in contact with a growing crystal is maintained by circulation and diffusion through the solution. increase of pressure, and, therefore, the greater the pressure the greater must be the concentration of the The solubility of most substances increases slightly with solution in order that crystal-growth may take place. When a crystal pushes a foreign body aside, it is due to the fact that the material necessary for growth is able to diffuse between the growing crystal and the foreign body. In Lavalle's experiment the lifting of the crystal occurred because there was present, between the crystal and the bottom of the glass, a thin film of solution, which was not expelled by pressure; it was by diffusion through this solution that additional material reached the supporting surface of the crystal. If two absolutely smooth parallel surfaces are separated by a drop of liquid that wets them both, capillarity tends to bring the two surfaces close together and to reduce the thickness of the separating film of liquid to a minimum. It is improb able that this film of minimum thickness, which may be no greater than the diameter of the space occupied by a single molecule of the liquid, can be completely expelled by capillarity, or even by external pressure that does not rupture the solids. It has been suggested that, under certain conditions, diffusion may take place directly through individual crystals, though this seems doubtful. However, fluids can certainly penetrate between the most closely associated crystals, and it appears probable that two crystals are never in such close contact that their respective atoms along the contact may not be more widely separated than they are within either crystal. Microscopic examination has proved that it is possible for solutions to penetrate between the mineral grains of even the most compact rocks and bring about important alterations and replacements.

In the course of my experiments two types of veins were obtained; one fibrous, with the fibres transverse to the walls, and the other crystalline with the individual crystals anhedral and approximately equi-dimensional. Fibrous veins (Fig. 1) were formed when the material for vein-growth was supplied through solutions occupying small closely-spaced capillary openings in the walls, while non-fibrous veins were formed when the vein-forming solutions circulated between the walls. With both types, the growing veins made room for themselves by forcing the enclosing walls. In these experiments vein-growth was slow, averaging about 0.2 mm. per month, and diffusion played an important part in the transportation of the vein-forming material. By changing the composition of the solutions banded veins were obtained. Some of the veins were branching, and frequently they contained inclusions of the wall-material. Opposite walls were approximately parallel when they

[1]C. G. A. von Weissenbach, 'Abbildungen merkwürdiger Gangverhältnisse aus dem sächsischen Erzgebirge. Leipzig, 1836, pp. 22, 23, and 26.

[2]J. Lavalle, 'Recherches sur la formation lente des cristaux à la température ordinaire. C.-R. Acad. Sci., Vol. 36, 1853, pp. 493-495.

[3]Stephen Taber, 'The Growth of Crystals Under External Pressure,' Amer. Jour. Sci., Vol. XLI, 1916, pp. 532-556; 'The Genesis of Asbestos and Asbestiform Minerals,' Bull. A. I. M. E., No. 119, Nov. 1916, pp. 1973-1998; 'Pressure Phenomena Accompanying the Growth of Crystals,' Proc. Nat. Acad. Sci., Vol. 3, 1917, pp. 297-302.

consisted of rigid material; lenticular veins (Fig. 2) were obtained when the walls, under the conditions of the experiment, were of flexible material.

Through the study of metalliferous veins, and especially of some of the simpler, though commercially unimportant, veinlets, found in regions of unaltered sedimentary rock, much evidence has been secured tending to prove that many veins were not formed by deposition in open fissures, but that the growing veins have forced apart their walls in the same way as was done by the veins produced in the laboratory. The miner who has

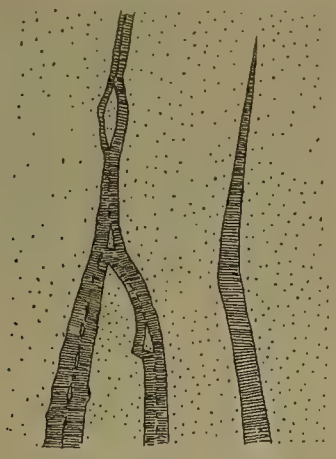


FIG. 1

had difficulty in supporting the walls of a vein must often wonder how the fissures could have remained open during the long period of time necessary for the deposition of the ore, and he should more easily comprehend a theory of vein-formation that does not require such im-

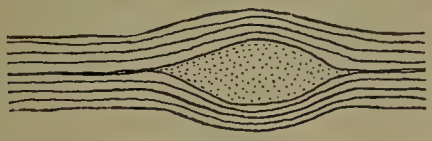


FIG. 2

probable assumptions. Ever since, as a student working in one of the deeper mines of the Mother Lode district in California, I had opportunity to observe the struggle to maintain openings in shattered ground while the ore was being extracted, I have been looking for a more adequate theory of vein-formation than those generally held in the past. Open fissures, comparable in magnitude to the many barren and metalliferous veins, are not known today at any place on the surface of the earth; and there is no reason for assuming that they existed during earlier geological periods. Of course, this argument does not apply to the replacement theory of vein-formation, but many veins have well-defined walls that show little or no evidence of replacement.

Banding, vugs, and comb-structures are commonly cited in text-books on ore deposits as proof of the deposition of veins in open fissures, but these structures are relatively rare. Moreover, as previously stated, all of these structures have been reproduced in the course of my experiments. In fact, it was extremely difficult to prevent the formation of vugs during the relatively rapid growth of the veins produced in the laboratory, where it was impossible to maintain absolutely uniform conditions. These vugs were due to a local deficiency of material necessary for growth, because of insufficient concentration or relative inaccessibility. If veins were formed through the gradual deposition of mineral on the walls of open fissures until the filling was completed, there should be a suture line near the centre where the opposite sides meet, but most veins show no evidence of such a structure, and in many small veins individual

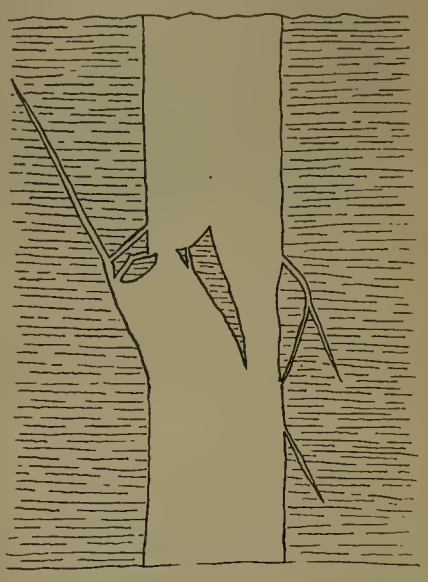


FIG. 3

crystals may be found extending from wall to wall. This is frequently true in the case of cross-fibre veins, and sometimes these veins show symmetrical shading or color-banding in such a way as to indicate that additions have been made to the fibres simultaneously at both ends.

Most veins are more or less lens-shaped, and this form is frequently accentuated, especially where the wall-rock is a highly laminated schist, slate, or shale, conforming in strike and dip with the vein. Sometimes the lenses are remarkably symmetrical, and again they may be quite irregular; in extreme cases they are bulbous, or almost spherical. Near such veins the planes of bedding or of schistosity usually conform closely to the curvature of the lenses in such a way as to prove that the walls have been slowly pushed apart by some force acting from within. It has been suggested that some lenticular veins may be igneous intrusions, while, according to another theory, the vein-forming solutions were under such heavy pressure as they ascended toward the surface that they were able to force apart the walls of small fractures and thus form the receptacles in which their load was deposited. There are many facts that argue against both of these theories, and it is obvious that neither is appli-

cable to lenticular veins of calcite formed near the surface in unaltered shales and limestones. If the enlargement of the vein-spaces was due to the pressure of fluids, very flat, lenticular, or tubular-shaped openings would be formed rather than a series of thick lenses connected by thread-like veinlets that in places are microscopic in size. Moreover, unless the spaces were immediately filled by the deposition of ore, the pressure of the fluid would have to be uniformly maintained in order to prevent collapse of the walls. Another argument against these theories is the presence within the veins of detached fragments of the wall-rock that have been only slightly displaced from their original positions. The gold-quartz veins of the southern Appalachian region are commonly lens-shaped, and some of them contain inclusions of the wall-rock which have reached their present positions with little rotation, for the schistosity of the inclusion is approximately parallel to that of the neighboring walls.

One of the best arguments supporting the theory that growing veins have made room for themselves is furnished by the presence in them of inclusions of the country-rock. In some of the simpler veins, where replacement has not been active, it is often possible to find on a wall the exact place from which a given fragment has been detached (Fig. 3), as the two surfaces would fit perfectly together if placed in contact. Some ore deposits are made up largely of angular rock-fragments, slightly separated from each other and cemented by vein-matter; and every gradation may be found between such breccia-veins and ore deposits that consist of a mass of reticulated or branching veinlets ramifying in all directions through the partly mineralized country-rock.

Pressure exerted during crystal-growth is also believed to play an important part in the formation of many replacement deposits. When a crystal of an ore-mineral in growing exerts pressure upon the minerals forming the country-rock, they may be forced into solution if their solubility is increased by pressure, thus making room for the enlargement of the replacing mineral. The solubility of most substances is increased by pressure, and the study of minerals under the microscope indicates that, in some instances, minerals have gone into solution where the pressure was greatest, and have precipitated again where the pressure was least. Pseudomorphs of one mineral after another, which are found in some ore deposits, indicate that some chemical interchange between the two substances has taken place, or that the solution of the replaced mineral brought about changes in the composition of the ore-bearing solution that resulted in the precipitation of the replacing mineral. On the other hand, calcite is frequently found completely replaced by pyrite, galena, and other sulphide minerals, exhibiting well-developed crystal-form, and showing absolutely no evidence of inherited structure. It seems probable that replacement in some cases has been as much a physical as a chemical process.

In a brief paper it is possible to discuss only a few of the many facts supporting the view that forces which have developed during crystal-growth have been an influential factor in making room for the deposition of ore-minerals. Sufficient has been said, however, to indicate that this process is of the utmost importance in the formation and enlargement of many orebodies.

By way of conclusion, a brief outline of my conception of the way in which most veins have been formed is here presented. It is believed that most veins have been deposited from solutions, mostly of magmatic origin, ascending under great pressure and at a high temperature; these solutions have penetrated slowly along the lines of least resistance, such as faults, planes of bedding or schistosity, or through porous strata. Where there were appreciable openings they have been filled; but it is improbable that extensive deposits have been formed at any considerable depth below the surface solely through the filling of open cavities. As the minerals crystallized from solution, they have exerted pressure on the inclosing rocks, thus tending to enlarge the space surrounding the growing deposits. In some cases the minerals of the country-rock have been rendered more soluble by the pressure and have been removed in solution. In most replacement deposits, however, it is probable that chemical interchange between the ore-bearing solutions and the country-rock has been an important factor. The transfer of material for crystal-growth through the extremely small openings between the crystals is probably more often due to diffusion than to circulating solutions. Cross-fibre veins have been formed through a process of lateral secretion, the material for vein-growth having reached the veins through capillary and subcapillarly openings in the walls.

Louis M. Dennis, of Cornell University, has recently devised a cyclic method for the manufacture of phenols from aromatic hydrocarbons, which is naturally applicable to the production of a large number of the hydroxyl derivatives of aromatic hydrocarbons. Benzine is treated with sulphuric acid, preferably fuming acid, to produce benzine-sulphonic acid in excess of sulphuric acid. This mixture is treated with benzine. As the sulphuric acid is practically insoluble in benzine, the latter takes up the benzine-sulphonic acid, but not sulphuric acid to any extent, forming a benzine solution of benzine-sulphonic acid, substantially free from sulphuric acid. This is treated with water, which dissolves the benzine-sulphonic acid and separates it from the benzine. The reactions are substantially as follows:

$$C_6H_5SO_3Na + 2NaOH \text{ (fused)} = C_6H_5ONa + Na_2SO_3 + H_2O$$

$$C_6H_5ONa + C_6H_5SO_3H = C_6H_5OH + C_6H_5SO_3Na$$

$$C_6H_5SO_3Na + 2NaOH \text{ (fused)} = C_6H_5ONa + Na_2SO_3 + H_2O$$

The principle of the solenoid has been applied by C. M. Mullan, of Portland, Oregon, for lifting stamps in a stamp-mill. The object is to avoid the loss of power through the friction of cams. The solenoid has frequently attracted inventors, and some years ago it was applied to rock-drills, but was finally abandoned.



CHEMISTRY BUILDING, TEXAS SCHOOL OF MINES

Texas School of Mines

By COURTENAY DE KALB

The opening of the new plant of the Texas State School of Mines and Metallurgy at El Paso is an event of general interest. The School started under fine auspices, with a well-equipped teaching staff and an enthusiastic director in the person of S. H. Worrell. The first session was opened in the autumn of 1914 in the Military Institute buildings on the mesa above Fort Bliss, east of Mt. Franklin. It was an unfortunate site and the old structures were wholly inadequate for the purpose. An accident enabled the institution to take a fresh start under happier conditions. In October 1916 a fire swept the buildings out of existence, but in the meantime the School had demonstrated a reason for being, and the selection of El Paso as a proper site had received justification. A few public-spirited citizens, V. E. Ware, Ted Cooley, and A. S. Valdespino, agreed to deed a more suitable piece of ground for buildings and campus if the State Legislature would appropriate the funds for substantial permanent structures and equipment. The response was prompt, and construction began in the spring of 1917. The new campus lies on the edge of the residential district of El Paso on the south flank of a spur of Mt. Franklin, and only a mile from the works of the Consolidated Kansas City Smelting & Refining Co. It is a rugged piece of ground, but possesses many advantages. It is sheltered from the winds, is easily accessible from the city, and is so situated that the buildings present a striking appearance, while the outlook over the Rio Grande valley and the mountain-dotted plains of Chihuahua is wide and inspiring. The architecture is a unique feature in America. On the initiative of Mr. Worrell the Bhutanese style was selected as being particularly adapted to the surroundings. The special feature of the Bhutanese type is that of a castellate building with massive walls that slope in graceful curves from the wide foundation to a roof conspicuous with its widely overhanging eaves. The lower story has few openings, beyond a stately entrance of oriental design. Being built partly into the mountain, the lower story thus serves mainly for storage, but the upper stories are abundantly lighted. The roofs, which have a sweep in keeping with the architectural styles characteristic of eastern Asia and Japan, are made of crushed red tile, mixed with an asphalt base that will not soften under the heat of summer. The broad eaves are painted pale green beneath, while the buildings are plastered in a rich cream color. Red, green, and yellow colors are repeated in the tiles, which are set into the medallions and are encircled by ornamental red brick forming the decoration between the upper row of windows. These are also outlined with ornamental red brick. This treatment gives a richness of color that brings the buildings into prominent relief against the brown slopes of the hills. The illustration shows the chemistry building before the contractors' rubbish had been completely cleared away. The main building is much larger and strongly suggests its Bhutanese prototype in the mountains of northern India. An interesting detail of the construc-

tion is that the stone for the walls was quarried from the site of the buildings, and the gravel for the concrete came from the wash at the base of the hills. The cost was thereby reduced so that the entire group, consisting of a handsome main structure, a chemical laboratory, dormitory, and pumping plant, were erected for little more than would have been necessary for the larger building alone in a less favorable situation. In addition to the foregoing, a milling laboratory is being erected. Mill-tests will be made free of charge, and the advantage of this opportunity is extended to mine owners outside of the State as well as to those in Texas. It is required, however, that satisfactory evidence be presented to show that the sample lots represent orebodies of sufficient size to justify tests for determining a suitable process.

The separation of mining schools from the State universities is rather common in the West, and ordinarily it may be considered a misfortune, since it tends to weaken both institutions. Texas, however, is so enormous in size, and is so clearly divided into distinct eastern and western centres of population by a great central zone of elevated barren desert, that this division of the university brings with it some noteworthy benefits. It means that the State must maintain practically two adequately equipped universities, and the School of Mines accordingly will serve the needs of an institution of higher learning for the area tributary to El Paso. In this respect it will perform a larger function than that of training mining engineers. Nevertheless its courses will be essentially technical, and it will offer some special advantages in metallurgy, since the American Smelting & Refining Co. has liberally extended to the School the privileges for purposes of instruction of its local plant, which is the second largest custom-smelter in America. The faculty includes S. H. Worrel, the dean; John W. Kidd, professor of engineering; H. D. Pallister, professor of geology and mining; F. H. Seamon, in charge of chemistry and assaying; with numerous instructors in technical subjects, and professors of mathematics, economics, languages, and other branches. The examining board of the State legislature, headed by Oscar Davis, has recently reported favorably upon the new plant, which insures liberal appropriations for expansion.

FERTILIZERS are a more recent development of our industrial life than is generally realized. The first importation of natural guano from the islands off the coast of Peru was in 1840. Nitrate of soda began to be imported and used 10 years earlier. The potash deposits of Germany were worked for the first time in 1862, and the phosphate deposits of South Carolina were not exploited until 1868. The discovery of the Florida phosphate deposits was made as recently as 1888, and the great phosphate lands of Wyoming, Utah, and Idaho were unknown until 1906. The first experiments in converting insoluble phosphates into the soluble acid salt, by means of sulphuric acid, were made by Sir John Bennett Lawes in 1837 at the Rothamsted Estate, Harpenden, England, which he used as an experimental farm.

Potash From Feldspar

Two methods which show promise have been presented lately for producing potash from feldspar, and of these one is already in operation in Canada, on a limited scale. It is the invention of Allan Grauel, of Kitchener, Ontario, who worked it out originally to obtain potash for a powder plant. His process, which is patented, consists in heating in a blast-furnace, 110-ton charges of feldspar, coal, calcium chloride, and limestone. At a high temperature the potash distills over as potassium chloride into a condenser, where it meets a current of steam, which dissolves it. The salt crystallizes in a high state of purity. The recovery is 90% of the potash in the feldspar which contains from 8 to 14% of potassium oxide. Soda vapors come over with the potash, but it is claimed that these are separated in a satisfactory manner. In operating the blast-furnace the slag is run into molds and converted into sewer-pipe, tile, and paving-bricks, having a peculiar porcelain-like surface. A company has been formed that has the enterprise in hand. Another process is the invention of J. P. W. Frazer and E. Miller of Johns Hopkins University, Baltimore. In this, the feldspar is ground and mixed with a weak solution of caustic potash, evaporated to dryness, and heated to 200 to 300° C. The subsequent treatments are leaching and neutralizing with whatever mineral acid is desired for the potash salt. The remaining product is aluminum sulphate. A feldspar containing 10% of potash will yield ¼ ton of 80% chloride of potash to one ton of aluminum sulphate. An interesting feature is that no great heat is required and the process seems to proceed along economical lines. The alum cake is useful in clarifying water and in treating sewage, and there is always plenty of sewage.

THE MALAY PENINSULA produces more than half the world's supply of tin in the form of concentrates, which are smelted chiefly at the extensive works at Singapore and Penang. These huge smelting plants, with a capacity of more than 7000 tons of tin per month, receive supplies of ore from Siam, the neighboring Dutch islands, and other tin-producing countries, so that the output is considerably in excess of the tin actually mined in the Malay States. Added to this is the tin from many small smelting plants in the Straits Settlements and the Malay peninsula, which is brought to Singapore for export. By reason of these facts the Straits Settlements takes rank as the world's largest exporter of tin, Singapore holding first place. The tin produced in the Federated Malay States yielded in 1916, on the metallic basis of a 70% concentrate, 43,870 tons, of a value of $36,630,721, as against 46,766 tons in 1915. In addition, 4383 tons of tin was produced in the non-federated Malay States, making a total of 48,253 tons for the entire Malay peninsula. The decreased production is attributed mainly to labor shortage, due to the increasing attractiveness of the rubber industry, which has assumed large proportions.

Output of Washington Mines

The value of the gold, silver, copper, lead, and zinc mined in Washington in 1917, according to the estimate of C. N. Gerry, of the U. S. Geological Survey, was about $2,238,000, an increase of 9% over the value in 1916. There was a decrease in the production of gold, silver, copper, and zinc, but an increase in that of lead. This increase and the higher prices of metals gave the output a value slightly above that of 1916, which was $2,048,350. Strikes at the Canadian smelters at different times during the year caused a curtailment of shipments from Washington, especially from the Republic and Chewelah districts. The plant at Trail, B. C., which owns and operates several mines at Republic, was idle in December. The Northport Smelting & Refining Co., however, operated a lead plant throughout the year and received much of the silicious ore from Republic.

The mine production of gold decreased from $577,655 in 1916 to about $486,000 in 1917. The Boundary Red Mountain mine, in Whatcom county, was among the principal gold-producers. The production of the Republic district was seriously affected not only by strikes, which closed the mines, but by labor troubles at the smelters. The output of this district, which was 45,313 tons in 1916, was reduced to about 36,000 tons. The Lone Pine-Surprise-Pearl property was, as formerly, the main shipper. The Knob Hill was next, and the Tom Thumb, Quilp, Hope, and San Poil were large contributers. A new shaft was sunk at the Knob Hill mine, and further depth was gained at the Last Chance and the Lone Pine properties.

The mine output of silver decreased to about 257,000 oz., or over 23%. The value of the output was about $208,000. Most of this silver came from copper ore mined in the Chewelah district, and a large part of the remainder from silicious ores mined in the Republic district. The ore output of both districts was less than in 1916.

The copper output decreased to about 2,000,000 lb., valued at $607,000. The output of ore and concentrate would have been much greater if the smelters had been able to receive it. At the United Copper mine, in the Chewelah district, sinking was in progress below the 1000-ft. level. Several dividends were paid during the year. The shipments of crude ore and concentrate averaged nearly 600 tons per month. The Sunset mine made shipments of copper ore during the first half of the year, and some was shipped from the Loon Lake property, in Stevens county. In May a shortage of coke prevented further shipments from the smelter at Trail. Several shipments of copper ore were made from the High Grade property, at Turk, in south-western Stevens county.

The lead output increased to over 9,000,000 lb., valued at about $824,000, representing an increase of nearly 4,000,000 lb. in quantity and $450,000 in value. The product came largely from carbonate and sulphide ores mined at the Electric Point property, in the Northport district, Stevens county, which was profitably operated during the year. Other properties in the district having first-class or milling lead ore are the Gladstone, Mineral Belt, Providence, and Iroquois. A few shipments were also made from the Bonanza mine, in the Bossburg district, Stevens county.

There was a marked decrease in the zinc output, because the Great Western and Last Chance properties ceased operations in 1916. The ore shipped from the Lead Zinc property at Metaline Falls, however, produced more than a million pounds of spelter. Part of



PART OF IDAHO AND WASHINGTON

the ore was shipped to Eastern zinc smelters and part was treated in the electrolytic plant at Trail, B. C.

The dividends paid by Washington mines for 11 months of 1917 amounted to $213,163. The mines making payments were the Electric Point, United Copper, Knob Hill, and Loon Lake mines.

COPPER production in Alaska in 1917 was about 88,200,000 lb., valued at about $24,000,000. This is less than the production in 1916, which was 119,600,000 lb., valued at $29,484,000, but is greater than the production of any other year. The reduction in output was due largely to labor troubles at the Kennecott-Bonanza mine. During the year 17 copper mines were operated, compared with 18 in 1916, 8 being in the Ketchikan district, 6 in the Prince William Sound district, and 3 in the Chitina district. The enormous output of the Kennecott-Bonanza mine, in the Chitina district in 1917, as in previous years, overshadowed that from all others.

SULPHUR mixed with organic refuse, raw phosphate rock, and soil, and kept moist for several weeks, results in converting the phosphate mainly to the soluble acid compound.

Idaho Mine Output in 1917

The value of the gold, silver, copper, lead, and zinc mined in Idaho, according to the statement of C. N. Gerry, of the U. S. Geological Survey, was about $54,000,000, an increase of more than $5,000,000 over the value in 1916. There were decreases in all the five metals except lead, in which there was a slight increase. Idaho was freer from labor troubles than the neighboring States, particularly Montana and Washington. The average prices of silver, copper, and lead were unusually good, and every effort was made to ship larger quantities of ore, particularly lead ore. The new lead smelter of the Bunker Hill & Sullivan, near Kellogg, began operations in July, and the lead plant at Northport, Washington, was active during the entire year, treating principally Idaho silver-lead ores. The output of crude ore and concentrate, both lead and zinc, increased from 527,266 tons in 1916 to about 527,000 tons in 1917.

There was a decrease in the gold output from $1,115,810 in 1916 to about $715,000 in 1917, due principally to the fact that the large dredge at Idaho City, Boise county, was idle. Shipments of gold bullion were made from the Marshall Lake district of Idaho county, where the Sherman & Corporal property has become a large gold-producer. The lead ore produced contains a small amount of gold, and the copper ore, especially that of the Alder Creek district, in Custer county, and the Richmond mine, in Shoshone county, contains considerable gold. A dredge that had been moved from Alaska to Prichard creek, near Murray, in Shoshone county, was ready for operation in December.

The production of silver was about 11,773,000 oz., slightly less than that in 1916, when the State produced 12,300,873 oz. The price, however, was so much better that the value of the output increased from $8,093,974 to about $9,536,000. The Coeur d'Alene region contributed most of the silver, and the largest producers were the Hercules, Bunker Hill & Sullivan, Morning, Hecla, Caledonia, Tamarack & Custer, Greenhill-Cleveland, Gold Hunter, Stewart, Consolidated Interstate Callahan, and Last Chance. In Boundary county, considerable silver is contained in concentrate shipped from the Idaho Continental property. In Lemhi county also silver is produced from lead ore. Increased output was made by the Morning, Hecla, and Bunker Hill properties.

The mine output of copper decreased from 8,478,281 lb. in 1916 to about 6,753,000 lb. in 1917. The value decreased from $2,085,657 to about $1,971,000. The properties at Mackay, in Custer county, and principally the mine of the Empire Copper Co., contributed most of the copper output. Shipments of copper ore were made from the Richmond mine, where the new tramway to Adair was operated. The Caledonia mine at Wardner produces ore containing copper as well as silver and lead. Toward the end of the year the plant of the National Copper Co. was again operated and made shipments of concentrate in November and December. Other shipments were also made from the Horst Powell property, north of Kellogg.

The output of lead increased from 375,081,781 lb. in 1916 to about 383,000,000 lb. in 1917, and the value increased from $25,883,643 to about $34,595,000. The principal producers in the Coeur d'Alene region were the Bunker Hill & Sullivan, Hercules, the Federal properties (especially the Morning mine), the Hecla, Greenhill-Cleveland, Caledonia, Success, Gold Hunter, and Consolidated Interstate Callahan. The Jack Waite property became a shipper of lead ore, and the Hypotheek increased its lead output. Having acquired the Frisco mill, the Tamarack & Custer Consolidated made shipments of lead concentrate in the last half of the year. In Lemhi county, the Pittsburgh-Idaho, Latest Out, and Gilmore made shipments of lead ore; in Boundary county, the Idaho Continental; at Arco, the Wilbert Mining Co.; and near Mackay, the Copper Queen and Homestake. Ore production in Lemhi county was less than in 1916.

As the price of zinc decreased considerably toward the end of the year, the average was only about 9 cents per pound. The State output decreased from 86,505,219 lb. in 1916 to about 80,000,000 lb. of recoverable zinc in 1917. The value was approximately $7,336,000. The output of the main producer, the Consolidated Interstate Callahan, decreased about 20%. This mine averaged over 5000 tons of ore and concentrate per month, part of which was a lead product. Shipments of zinc ore or concentrate were also made from the Morning, Success, Rex, Highland Surprise, Constitution, Greenhill-Cleveland, Frisco, Black Hawk, Marsh, Douglas, Ray-Jefferson, and Nabob. Most of the zinc came from Shoshone county, but the North Star mine, near Hailey, in Blaine county, belonging to the Federal company, became a producer of zinc concentrate during the year. A great part of the zinc product was sent to the electrolytic plant at Great Falls, Montana, and part of the ore, such as that from the Douglas mine, was concentrated after being shipped.

The dividends from Idaho mining for 11 months amounted to nearly $6,000,000. The principal contributors were the Hecla, Bunker Hill & Sullivan, Caledonia, Hercules, Consolidated Interstate Callahan, Pittsburgh-Idaho, Wilbert, Empire Copper, Big Creek Leasing Company, Douglas, Richmond, Black Hawk Leasing Company, and Tamarack & Custer.

HOT SPRINGS are numerous in Alaska. The cause is traced mainly to expiring volcanic activity. A recent bulletin (Water Supply Paper 418) issued by the U. S. Geological Survey, describes the hot springs of Alaska, and states that they do not seem to be related to great structural features, but are associated with intrusive rocks. Many of those in the Yukon basin are related to granitic masses intruded into the schists, and their chemical analyses show that part of the solid carried in solution was derived from minerals in the schist.



PHOENIX, ARIZONA

A Review of Mining in 1917 and Outlook for 1918

The Arizona copper output for 1917 when all figures are in will show a gain of 25,000,000 to 50,000,000 lb. over 1916. But for the I. W. W.-promoted strikes, beginning with the attack on New Cornelia that was intended to prevent the property from coming into production in 1917 and did delay its entry for a matter of two months, Arizona would have made over 300,000,000 lb. more of copper in 1917 than in 1916. The increase over 1916, in spite of strikes, is to be credited to greater and more efficient mechanical equipment and to large resources in high-grade ores in the vein mines that had been made ready for extraction in advance of the breaking of trouble. The present year's output starts under the handicap of a great reduction in high-grade reserves and a metal price that will not permit the mining of the low-grade ores. The checking of output, while more ore is opened than can be profitably mined at 23½c., with some closing-down of mines by small producers, mainly shippers of custom ore, is to be anticipated; in fact, has begun. Decrease in working forces necessarily attends, and with the curtailment and suspension of work on developing properties, which is in progress because of high costs, the difficulty in financing under existing general conditions, and the unpromising price-outlook for copper metal, there is being considerable disorganization of working forces brought about, together with an increase in the surplus of labor that has prevailed in the copper districts for some time. That the price of copper was not put above 23½c. was a disappointment in Arizona, particularly to the small producers, many of whom had been maintaining shipments at a loss in the belief that price would be advanced and that they would be out less by accepting a small loss in the interim than closing-down their properties and assuming the extra expense of re-opening when the price did advance. Advance in copper price to 26c., with assurance that such price would not be decreased, would enable at least 10,000,000 lb. more copper per month to be produced from Arizona than can possibly be made on a 23½c. market. No one familiar with mining can possibly figure that decreased price for metal can bring about higher output. The lower the price the higher the grade of ore that must be mined, and every miner knows that the high grade is a limited quantity, either present or possible of attainment, in any mine, and that in the development of high-grade it is impossible to use more than a limited number of men. In Arizona labor conditions are in a fairly settled state, supplies are coming through fairly well, and other conditions are favorable to a year of increased metal output, attended by considerable additions to ore-reserves through the opening of new properties; the metal price represents the only retarding feature.

Cochise County. The Denn-Arizona has placed pumps in the 1430-ft. level reardy to clear water from the 1600-ft. level as soon as some small supplies are received. Water is now a little below the 1500-ft. level. Calumet & Arizona is driving on the 1600-ft. to the Denn line, where promising ore was recently found on the 1400-ft. level of that property. The December production of C. & A. is 5,816,000 lb., compared with previous 1917 high production in May of 5,688,000. The Copper Queen December production from Warren district ores was 9,000,000 lb. copper, compared with previous high in May of 8,600,000 lb. on the planned 8,000,000 lb. monthly production during 1917. Shattuck alone in the Warren district showed decrease in December, with an output of 626,612 lb. for the month. The decline in part was due to the preparation of lead-silver orebodies for the extraction of 400 tons per day for the mill, which is being erected rapidly and will be ready for operation in May, and to the larger forces directed to development in high-grade copper-zones. More development of the higher grade will be necessary on the part of nearly all the vein-copper producers in the State with copper remaining at 23½c. The price will not permit mining of the low-grade ore. Owing to the diverting of labor to higher-grade development and the limited working room, decline in the State's monthly copper production is anticipated until re-adjustment is obtained through work in succeeding months and the losses are overcome. This will be attended by the closing down of small shipping properties in various districts of the State, representing probably 1,000,000 lb. copper per month, which have been hanging on, hoping for an increase in price.

Pima County. New Cornelia made 2,260,000 lb. of copper from cathodes, 500,000 lb. from shipping ore, and 1,090,000 lb. from cement copper in December, a total of 3,850,000 lb. for the month. Four million pounds per month is indicated as readily within the capacity of Cornelia in succeeding months. Plans for the erection of a smelter on this property are being matured and specifications are under way. There is no intention, however, of erecting a smelter this year, unless there should be a marked decline in the cost of materials. Ajo Consolidated underground development by Cornelia is well under way and will increase steadily. Ores in this property as well as in the steam-shovel pit of Cornelia are averaging higher in metal content than advance exploration figures indicated.

Yavapai County. Dundee has closed down pending completion of arrangement by which it will use the new Verde Extension traffic tunnel to gain entrance and make a raise from around the 900-ft. level to the shaft it has been sinking. Costs of pumping and hoisting will be dispensed with under this plan. Jerome Victor Extension is expecting to recover the 1200-ft. level from the water and resume development there at an early date. The 1200-ft. has been opened slightly; the showing there is promising for the small extent that it has been possible to follow it. Water increases, pump troubles, and machinery break-downs have interfered at several times. The Verde Extension new blower has greatly improved conditions underground. The fire area has about been disposed of. Progress with the smelter of this company is going on well. The Verde Combination ore find on the 600-ft. is near the Gadsden line and is encouraging, although more depth is considered requisite to establish individual value for the strike. The Calumet Jerome is in the same situation, requiring more depth to enable deductions of value. The Del Monte closing-down is apparently for an indefinite period, although additional equipment was received and in course of installation when the closing order came, while a year's stock of general supplies is on hand at the camp and there is an abundant sum of money in the treasury for another year's work. Labor is

plentiful in the district, a surplus having been on hand for some time. The demand for an increase of $1 per day both above and below ground will probably be adjusted by administrator Meyers. The I. W. W. disturbing elements are held to be responsible for the demands. Costs of living in the district are asserted at this time to be no higher than when the present wage scale was agreed upon in June. The administrator is now investigating the costs of living, upon alleged increase in which the demand for higher pay is based. The present wage is $5.15 per day.

Gila County. The development of high-grade copper ore on the 1000-ft. level at Iron Cap indicates an exceptionally important strike for the Globe district and lends much encouragement to the exploration that Old Dominion, Commercial, and Superior Boston have been carrying on at depth, with attendance of good results. The outlook is also improved for New Dominion and several other developing properties. Iron Cap ore is in bornite and on the 1000-ft. level averages 12½% copper with about 10 oz. silver. On the 800-ft. level the ore has an average width of 8 ft. and on the 900-ft. of 12 ft. and carries 10% copper. Sinking from the 1000 to 1100-ft. has been started. Arizona Commercial is opening new stopes between the 1500 and 1400-ft. levels and pushing development vigorously with good results on the 800, 1000, 1200, and 1500-ft. levels. The water area has been lowered between the 1200 and 1500-ft. levels. Poryphry Copper Co. is to block out ore, preparations being under way to cut stations at 530 and 630 ft. in the shaft and start driving.

TONOPAH, NEVADA

Tonopah Mining.—Tonopah Belmont.—Tonopah Extension.—West End Con.—Tonopah Halifax.

The Tonopah Mining Co. shipped 35 bars of bullion valued at $67,500, representing the final clean-up from the plant at Millers for December. A conservative estimate of the time required to treat the old dumps, based on 300 tons per day, is one year. Last week 2400 tons was milled averaging $7.50 per ton. During the past week 57 ft. of development has been done in the Silver Top and 58 ft. in the Sandgrass. Raise No. 386 at the Silver Top disclosed no ore in the hanging wall of the Valley View vein. On the 1140-ft. level of the Sandgrass the raise on the Upper Sandgrass vein holed through and stoping has been started. Last week's production was 3650 tons.—— The Tonopah Belmont Development Co. shipped 57 bars of bullion valued at $102,517 and 43 tons of concentrate valued at $19,350. On the 700-ft. level east drift No. 721 on the Shoestring vein shows a 2½-ft. face of medium-grade ore. Raise No. 8 on the same vein shows a 2-ft. face of good ore. Stoping has been commenced from raise No. 8. On the 800-ft. level a raise from the Occidental vein cut the faulted segment of the South vein, showing 4 ft. of good ore. On the 900-ft. level north-west cross-cut No. 9025 cut a branch of the rhyolite vein, exposing good ore. The production last week was 2269 tons. ——The Tonopah Extension Mining Co. recently cut the extension of the O. K. vein on the 1680-ft. level of the Victor. The width of the vein has not yet been determined, but the dip flattened as did the Merger vein that was cut a short time ago. The 1600 west drift of the Victor advanced 31 ft. on a 4-ft. face of ore. On the 1540-ft. level winze No. 1501 continues in ore. At the No. 1 shaft on the 1260-ft. level raise No. 469 is on a 3-ft. face of ore. At the No. 2 shaft 87 ft. of development has been done and 153 ft. at the Victor. The past week's production was 2380 tons.——At the Ohio shaft of the West End Consolidated Mining Co., drift No. 535 continues in good ore. Winze No. 534 cut a fault, and the vein has been picked up on the other side. In raising out of No. 528 raise some exceptionally high-grade ore has been found. The 814 raise still continues in quartz; the hanging wall of the vein has not been reached. The output last week was 1019 tons.—— At the Halifax Tonopah Mining Co. a small stringer of quartz was found in the cross-cut No. 1018. The stringer shows good ore and driving has been started on it. The output last week was 56 tons.——The Jim Butler produced 412 tons, the MacNamara Mining Co. 416 tons, the Montana 109 tons, the Rescue 66 tons, and Midway 46 tons, making the total production at Tonopah 10,423 tons with a gross value of $182,403.

MONTERREY, MEXICO

American Mines Being Worked.—La Compania Metalurgica

Comparatively few American mining men have as yet returned to their properties in Mexico, despite the improved internal conditions in some parts of the country. It is stated that in the Guanajuato district little effort is being made to resume operation of foreign-owned mines, although there are some such properties which have kept up their output during nearly all of the protracted revolutionary period. In the mining districts, situated more adjacent to Monterrey, there is a considerable renewal of development activities. In the Cerralvo and the Concepcion del Oro districts American-owned properties are again being worked to the fullest extent that the hindrance in getting in supplies and shipping out ores will allow. It is noteworthy that the mines that are owned by Germans are about the only ones that are doing a large production at this time. This is true as to the Mapimi and Bermejillo districts as well as in several of the districts of Chihuahua. A syndicate of Germans has recently acquired valuable mineral holdings in the Pachuca, El Oro, and Guanajuato districts, according to advices received here. It is stated that these mines were forfeited from American owners by the Mexican government for alleged failure to pay taxes and other assessments.——Arrangements are being made for the re-opening of the large smelter of La Compania Metalurgica at San Luis Potosi. This is an American concern. J. D. Wilson of New York, assistant manager for the company, is now in San Luis Potosi looking after matters connected with the plant's early resumption of operations. It is stated that a large supply of coke has been received and that ample ores are on hand and in prospect to keep the smelter going. With improved transportation facilities it is expected that there will be no cessation of the smelter's run when it is once again started. Revolutionary conditions in the State of San Luis Potosi are said to be much improved over what they were only a few weeks ago. Bandits continue to menace the division of the National Railways of Mexico that runs between San Luis Potosi and the port of Tampico.——In the States of Coahuila and Tamaulipas two or three new independent revolutions are now in progress, but none of them has as yet gained much headway. Several smaller towns have been raided recently and skirmishes between the different revolutionary bands and Carranza soldiers are of almost daily occurrence. The town of Cuatro Cienegas, State of Coahuila, the former home of President Venustiano Carranza, and where the distillery that he operated is situated, has been in the hands of revolutionists for several weeks.——Several of the larger mines in the more remote mountain districts of the State of Durango are being operated, but on account of the lack of transportation facilities the ore production is not being shipped. The division of the National Railways of Mexico, between Torreon and Durango, has been out of commission, except at brief and far removed intervals, for more than eight years. The smelter of the American Smelting & Refining Co. at Asarco is on that line. It was reported recently that this plant was about to be again placed in regular operation, but there has been no verification of this statement received here. It is deemed improbable that revolutionary and banditry conditions would at this time permit the re-opening of the plant unless a large and constant guard of troops were maintained to afford it protection.



ALASKA

(Special Correspondence.)—The Union Power Co. has been incorporated under the laws of Alaska to construct a hydro-electric plant to furnish power to all of the operating mines in the Willow Creek district. The incorporators are: J. F. Wood, Conrad C. Hage, and M. M. Henley. It is proposed to install two 200-kw. generators in the spring and build 12 miles of transmission line to supply the mine, and the equipment will be increased as necessity develops. A site for the plant has been chosen near Mile 28 on the Willow Creek road.

Anchorage, December 19.

(Special Correspondence.)—The first copper-concentration mill to be installed in the Ketchikan district has been in operation for three months at the Salt Chuck mine, Kasaan bay. This plant has a capacity of 60 tons per day and is quite simple, consisting of a Blake crusher, ball-mill, drag classifier, and flotation rougher and cleaner cells. A Deister table was included but was found to be unnecessary. The power is furnished by a 150-hp. hydraulic plant which also supplies some power for mining operations. A gas or steam plant will likely have to be added to prevent the necessity of closing down during dry spells. The ore contains bornite and chalcopyrite with epidote and gabbro in the gangue. An extraction of over 90% is claimed. The property is owned by J. E. Chilberg, of Seattle. F. Chapman is manager and G. H. Bannerman, superintendent. The preliminary examination and suggestions for equipment were made by W. L. Polson in April 1915.——A small plant for treating a complex copper-zinc-lead ore is under construction by the J. L. Harper Mining Syndicate at Complex, North Arm, Moria sound. The Rush Brown, Sulzer, and It mines are shipping steadily and supplying considerable ore to the smelters. The Granby M. & S. Co. is preparing to re-open the Mamie mine at Hadley. This company is also doing considerable development work at Rich Hill, and several other places in this district.——Exploration underground is being maintained in the large disseminated mineral zone on the Apex group at McLeans Arm.——The Ketchikan district should be an attractive field for mining men on account of the large amount of easily accessible property containing ores previously overlooked as being too low grade for shipping to the smelters.

Ketchikan, January 10.

The Marble gold mine in the Willow Creek district has been sold to Butte people for $500,000.

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—A disastrous explosion occurred at Bisbee on the afternoon of January 9 when over 3000 lb. of blasting-powder was prematurely exploded on Sacramento hill where the Copper Queen Co. is carrying on extensive steam-shovel operations. Two men were killed, two fatally injured, and eight others seriously hurt. One hole had been loaded ready for firing and the powder-men were putting in the primer and electrical connections in another when the explosion took place, the cause of which is not known. The two men killed were Sidney Drakefield, an engineer in the employ of the company, and Modesto Vastido, a laborer. The two men who are said to be fatally injured were Carlos Calderson and Juan Nunez. The men seriously injured are Nat. Anderson and J. D. McBride, powder experts, the remainder being Mexican laborers.

Douglas, January 12.

MOHAVE COUNTY

(Special Correspondence.)—The shaft of the Record lode has reached a depth of 350 ft. and development by cross-cutting and driving is to be carried on as soon as a station is cut.——The force of men at the United Oatman has been increased. The adit that is being driven in the contact vein is in nearly 800 ft. The west cross-cut has been advanced about 250 ft.——The ore opened up in the West drift of the Gold Road Bonanza is the full width of the face of the drift and is all commercial ore.——Shaft-sinking at the Gold Ore has been completed, and a sump and station are being cut. An electric pumping plant is being placed on the seventh level.

Kingman, January 14.

YAVAPAI COUNTY

(Special Correspondence.)—The adit of the Fortuna Consolidated Co. is now in over 800 ft. and, according to calculation, should cut the main east and west vein any day. The adit is being driven on a north and south vein to cut an east and west vein series. For the last 100 ft. the adit has been in ore of varying grade. A portion of the ore is rich and it has been officially confirmed that shipments can now be made, which should net the company at least $100 per ton. The principal mineral of the ore is gray copper.

Prescott, January 18.

CALIFORNIA

NEVADA COUNTY

(Special Correspondence.)—By means of a concrete dam and long flume the Golden Center Co. has diverted the flow of considerable water from surface streams to Rhode Island ravine, which empties into Wolf creek. During heavy storms numerous shallow shafts and old surface workings filled with water that afterward seeped into the mine, imposing a heavy strain on the pumps. With this water diverted, the management expects to unwater the lower workings without further difficulty. The mill is running steadily on good ore from the western workings of the mine. The shaft is being sunk to 2000 ft.——The shaft of the California mine, in the Deadman Flat section, has been sunk to a depth of 800 ft., and cross-cutting begun to explore promising ground. This is the deepest point to which developments have been carried in the district, but thus far results have been rather disappointing. The California is controlled by King C. Gillett of Los Angeles. ——Eastern capital has taken a bond on the Mayflower mine, owned by W. H. Martin of Nevada City. It is reported that a fund of $150,000 has been provided for comprehensive developments and the purchase of new equipment. The Mayflower was formerly a rich gold-producer but has attracted little attention in late years.——Placer mining at You Bet is again active and the old camp is showing more life than for many years. White miners are largely employed and the Board of

Supervisors has ordered the establishment of a voting precinct.

Grass Valley, January 21.

SHASTA COUNTY

(Special Correspondence.)—The Afterthought mine and oil-flotation plant at Ingot will be started up before the end of the month with a full force of men, according to George L. Porter, president of the company, who has just returned from St. Louis. The works were shut-down on November 30 owing to a defect in the oil-flotation process and the shortage of cars. Both these troubles have been remedied. The ore is subjected to two flotations; the first removes the sulphide from the gangue; this concentrate is roasted and again floated when the zinc is separated from the copper. The separation is said to be fairly sharp. The company will erect 20 cottages for the convenience of its employees. It spent $650,000 last season in building its oil-flotation plant, paying off debts, and making other improvements at the mine. J. T. Milligan, a mining engineer of Colorado Springs, and J. M. McClave, a metallurgist, have arrived at Ingot to assist the general manager, J. T. Robertson.

Redding, January 14.

SISKIYOU COUNTY

(Special Correspondence.)—A. W. Boslough and Louis G. Glieve of Ashland, Oregon, who have a three-year lease from John R. Clute on the S. B. Bar placer ground of 40 acres, on the Klamath river one mile below Gottville, are assembling machinery to sink a two-compartment shaft. This property in early days, when known as the old Manzanita Bar mine, produced $200,000 in gold.——T. K. Anderson of the Pilot Knob group of quartz mines on Empire creek is operating on a large body of ore.——Fifty men are employed in the Grey Eagle Copper mine near Happy Camp, and arrangements have been made to continue operations during the winter. In the coming season the management is planning to build a railroad to some point on the Southern Pacific or to tidewater, and a flotation plant is also under consideration.——The Blue Ledge copper mines produced 800,000 lb. of copper during the past year. The county produced 15,000 oz. silver.——In addition to the mill erected last spring, a new cannon-ball mill with a capacity of fifty tons has been erected on the Rancherie mine near Hornbrook. This property is a cement-gravel mine under sandstone rock and was formerly known as the Black Jack mine. ——Joseph Freshour is operating his placer drift mine on Lum Grey creek near Gottville. The mine is equipped with a steam-hoist and a water-wheel pump.

Hornbrook, January 15.

TUOLUMNE COUNTY

(Special Correspondence.)—Through the Pacific Coast Mines Corporation, Boston capitalists have taken over the App, Dutch, and Sweeney mines, at Quartz. The corporation has been authorized to issue 1,499,495 shares of stock, besides bonds in the sum of $300,000, to the owners, to complete the purchase price. It is stated that the properties will be worked on an extensive scale, and that during the coming summer a mill with a daily capacity of 700 to 800 tons will be erected. Documents recorded in this county during the past few days show that the Springfield Tunnel & Development Co. has obtained the right to drive an adit not to exceed 8 by 8 ft. through land near Springfield owned by John Wight; also the right to construct roads across said land, and to erect any buildings necessary upon the property. In return the company grants to Mr. Wight the surface right to a certain tract of land comprising 120 acres; to pay to him 25% of all gold extracted from his ground, and the use of the proposed adit to open his own ground, provided he does not disturb or delay the company's operations in so doing. It is said that one of the richest gravel deposits known in the company's holdings, on the west side, can be reached by the middle of the present year by driving an adit through the Wight land. The long adit from the canyon of the Stanislaus river will not be abandoned, but will be completed at a later time to open certain other ancient channels in the property that cannot be advantageously explored and worked throuh the proposed adit on the west. It is announced that operations will be resumed at once and vigorously pushed.——The Confidence mine shaft is being deepened another 100 ft. from the 1100-ft. level, a contract for this work having been taken by C. Sullivan.——Ore speckled with gold is being taken out of the Fifth Ward mine, near Arastraville, recently bonded by Robert Marshall of Sonora to John W. Bates. The vein is from 4 to 7 in. wide. The rich ore was uncovered in a winze near the face of a 208-ft. adit.——A 5-stamp mill has been purchased for the mine on the Hales & Symons property, just south of Sonora, which



TUOLUMNE COUNTY, CALIFORNIA

is being developed under bond by C. R. Rives and associates. A head-frame will also be erected and the property worked on a larger scale than in the past. Shafts have been sunk in the large vein in several places an in every instance ore ranging from good to high-grade has been found.

Sonora, January 12.

COLORADO

DENVER COUNTY

(Special Correspondence.)—The plant of the Chemical Products Co., at Denver, was visited by a disastrous fire of incendiary origin on January 14. The loss is between $50,000 and $75,000. The company has been producing vanadium on sublet contracts for the British government. The plant will be re-built immediately to discharge these and other contracts.

Denver, January 15.

TELLER COUNTY

(Special Correspondence.)—The important development of last week has been the finding of pay-ore in the breast of the Roosevelt tunnel, at a depth of 2100 ft. in Rose Nicol territory, 300 ft. east of the main shaft and near the east line of the Portland estate. The vein, pronounced the Hidden Treasure vein of the Portland system, sampled $3.60 to $12.80 per ton; it is confidently expected an ore-shoot will be opened.——The Rose Nicol is under lease for a six-year term to the Camp Bird Mining, Leasing & Power Co. During the past week the company finished sinking on the Rose Nicol on the western slope of Battle mountain, having reached a depth of 981 ft., which corresponds to the 1000-ft. level of the Portland Gold Mining Co. No. 2 shaft, from where a drift has been run on ore into the Rose Nicol ground, and to 1200 ft. in the Trail

mine of the United Gold Mines Co. to the west. Shipments will shortly be moving from the Rose Nicol.——The annual stockholders meeting of the Golden Cycle Mining & Reduction Co., a West Virginia corporation, will be held at the office of the company at Colorado Springs on Thursday, January 31, for the election of a board of seven directors.——The annual stockholders meeting of the Portland Gold Mining Co. for the election of directors has been called for February 18, at Cheyenne, Wyoming. Stockholders of the company will be paid a 3c. dividend, $90,000, on January 20; with this payment they will have received $11,047,080 in dividends.——The annual meeting of the Vindicator Consolidated Gold Mining Co. will be held at Denver, on February 14. At the last meeting, the directors determined to pass the January quarterly dividend. The Vindicator company has paid $3,713,500 in dividends.——A new ore-shoot on the C. K. & N. vein has been opened up by lessees of the El Paso Consolidated Gold Mining Co., between the 900 and 800-ft. levels of the No. 1 shaft on the western slope of Beacon hill. The vein, which is 3 ft. wide, will ship at better than one ounce gold per ton.——Annual meetings of the Mary McKinney Mining Co., Elkton Consolidated Mining & Milling Co., and Isabella Mines Co. will be held during the month of February.

Cripple Creek, January 19.

MONTANA

LEWIS AND CLARK COUNTY

(Special Correspondence.)—The Helena Mining Bureau held its annual meeting the middle of January and elected a new board of directors and officers. The report of the secretary-treasurer showed that $27,000 worth of ore was paid by the smelter and that the main shaft is down 300 ft. vertically. The stockholders appeared well pleased with the showing. An additional 100 ft. is to be added to the depth of the shafts in the near future. The hoisting apparatus is ample and a two-ton skip is used in raising ore and waste to the surface. The mine is in Grass Valley district, about four miles west of Helena.——The Marysville Gold Syndicate, which has been developing property in Marysville district for the past year, has closed-down. The syndicate was composed mostly of Duluth people. The sum of $150,000 was expended in mining and in securing options on mining ground. Final action depended on reports by mining engineers that were insisted on by Eastern capitalists. These engineers visited the property lately and after an examination extending over 17 hours they reported adversely. As to the future of the syndicate property nothing is known at this time.——The Barnes-King Mining Co. is operating very successfully on the Shannon mine, which adjoins the syndicate property on the west. The Shannon shaft is down 500 ft. and an additional 150 ft. is being added. When the shaft has been sunk to the 650-ft. level drifts are to be run east and west. The 500-ft. level disclosed rich gold ore. ——Denver people have taken over the Mountain States mining property at the head of Warm Springs creek, Jefferson county, and are unwatering the main shaft, which is down 150 ft. The ore is silver-lead; the property was worked 15 years ago.——The Liverpool mine in Lump gulch, Jefferson county, has been purchased at a tax sale for $2500 by a Helena syndicate. It is developed by a 750-ft. shaft. The ore is silver-bearing and high-grade. The property was owned by the Pittsburgh-Montana company.——The Amalgamated Silver Mines Co. is deepening an old shaft on Free Coinage ground in Lump gulch. The shaft, which was down 180 ft. is being sunk to the 250-ft. level. The ore shipped from the workings averaged 115 oz. silver per ton. The company controls 35 claims in the camp, all contiguous.

Helena, January 16.

SILVER BOW COUNTY

(Special Correspondence.)—The High Ore and the St. Lawrence, in the Butte district, both of which have been closed for repairs for a long time, resumed operations on January 14. The former will employ 500 and the latter 400 men. Both will start hoisting ore immediately, and should increase the daily production at least 1700 tons. The starting of these two mines means that practically all of the large mines in the district are operating to capacity.——The production of the East Butte for December amounted to 2,500,000 lb. of copper as compared with 2,033,000 lb. in November, an increase of 467,000 lb. Those figures make a record month for the company, the previous highest having been September 1917 with a production of 2,203,300 lb. This record is aided to some extent by the treatment by this company of the Davis-Daly Copper Co. ore, which has been of good grade, the first class assaying from 10 to 16% copper, while the second class usually ran from 3 to 5%.

Montana's output of minerals for the past year shows a decrease in value of $20,000,000 as compared with the production of 1916. This was caused to a great extent by the idle period of over two months when the mines in the Butte district were closed on account of labor trouble. Metal prices were high, with the exception of zinc, but the mining profits were not unusual, because of the high cost of material and of labor. Gold, copper, silver, and zinc showed a decrease in the output value and lead an increase.



BUTTE MINING DISTRICT

Butte, January 16.

NEVADA

HUMBOLDT COUNTY

(Special Correspondence.)—The Rochester United, which joins the Merger, has recently found a shipping grade of ore, but not in sufficient quantities as yet. In a raise from the drift on the Silver King adit-level 15 in. of ore runs 20 oz. in silver and $8 in gold per ton. The drift also is going ahead and, while for a time the vein-filling was badly broken up, it is now apparently entering another ore-shoot. The vein-filling is of good-looking quartz from which encouraging assays have been received.

Rochester, January 17.

MINERAL COUNTY

(Special Correspondence.)—The north-west drift on the

1000-ft. level of the Calavada mine at Luning is advancing four feet per day between monzonite and dacite along an oxidized vein carrying bunches of high-grade oxidized copper ore. It will connect with the new shaft on the Chief claim, which is designed for ventilation of the main workings and to develop an ore-shoot that comes to the surface near by. From this ore-shoot 100 tons of 12% copper ore was extracted near the surface. The winze that is being sunk from the 1000-ft. level near the main shaft is down to the 1135-ft. point.——The Luning-Idaho mine is extracting some unusually handsome specimens, running high in copper, from Stockham adit No. 2, where work is now being concentrated.

The R. B. Todd mine will explore a 6-ft. vein at the top of Todd mountain that runs $12 per ton in gold and silver by a short adit.——A cross-cut into the hanging wall from the face of the lower adit of the Kirchen Mines Co. St. Patrick mine has opened a small body of rich ore, assaying as high as 55% copper.——A pleasing feature of the Congress mine development of late has been the uniformity of ore in the big vein. The east drift for some time has seldom averaged less than 5% copper. In the new vein opened on the 150-ft. level of the Pilot company's Champion mine the sulphide ore is spotty but is of high grade. The Pilot is shipping 25 tons per day.

Luning, January 21.

NYE COUNTY

(Special Correspondence.)—The Tonopah Mining Co. has started shipping 150 tons of mine-ore per day to the Belmont mill, and 300 tons to the Desert mill from its old dumps. It is estimated that sufficient ore is on the dumps to keep the Desert plant working for a year, and after all this material has been treated the old mill at Millers will be dismantled. Portions of the Tonopah mine still containing promising ore will then be opened to lessees. By securing the ore from the Tonopah mine the Tonopah-Belmont Co. is enabled to operate its plant at capacity. This mill is also receiving custom ore from several outside properties.——An examination of the Tonopah Divide mine, at Gold Mountain, has been made by A. I. D'Arcy and H. V. Wittee on behalf of George Wingfield and associates. It is rumored here that the Goldfield Consolidated Co. is negotiating for control of the Tonopah Divide, which has developed splendidly in the past three months. At a depth of 400 ft. a large vein of $25 gold-silver ore is reported. H. Cal Brougher is principal owner and William Waters is superintendent.——The Consolidated Mayflower Mines Co., operating the Mayflower mine at Pioneer, has started shipments to the Mammoth smelter, at Kennett, following an agreement entered into with the United States Smelting, Refining & Mining Co. The shipping product is being drawn from the 300-ft. level, where ore showing free-gold has been uncovered. The 15-stamp mill is crushing ore from the 200, 300, and 400-ft. levels. Preparations have been made for driving a 1400-ft. drift from the 300-ft. level of the Mayflower shaft to connect with the Starlight shaft. The drift will follow the Mayflower vein, and raises will be extended at intervals to prospect the orebody. Water for the mill is pumped from below the 500-ft. level. W. J. Tobin is manager.

Tonopah, January 20.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—The Oaks Co. has opened up new ore in the Pacific mine during the past week.——More men are being used at the Socorro plant and construction work is progressing rapidly. It is understood that some type of ball-mill will likely be used for coarse grinding instead of stamps; this will be a change in the Mogollons where stamps have been used steadily for 25 years.——The Mogollon Mines Co. tonnage record for 1917 was one of the largest in its history. While no special changes have been made in the milling process, many minor improvements have been put into operation.——Belated snows are now falling in mountains, which supply the various mills with summer water.

Mogollon, January 15.

OREGON

JACKSON COUNTY

(Special Correspondence.)—W. A. Sharp of Grants Pass, Oregon, and his brother, L. C. Sharp, of Plattsmouth, Nebraska, have purchased the placer land known as the Hydraulic mine, on upper Jump-Off-Joe creek in the north end of Jackson county, from Mrs. Elizabeth Smith of Ashland. It is the intention of the new owners to erect a hydro-electric precipitating plant.——A new find of cinnabar has been reported uncovered in the Trail Creek district, between the Elk Creek and Meadows districts north of Gold Hill, and north of the Lake Creek district.——Much progress is being made on the 900 and 1200-ft. drifts at the Ray & Haff gold mines, two miles north of Gold Hill, which is being operated by J. W. Davies of Sacramento. The 900-ft. drift will open up a large body of ore on a new level, while the 1200-ft. drift will connect with a 1200-ft. drift into the vein from the opposite side of the hill.

Gold Hill, January 15.

(Special Correspondence.)—The Golconda chrome mine at Takilma, owned by Collard, Moore & Collard, which has been idle since September, will resume operation at once under the management of R. J. Rowen, who has been operating in the Gold Hill district for the past two years. He has had a contract for the ore output, but difficulties in production by the owners caused delay and complications which resulted in litigation. Mr. Rowen is being financed in the construction of a mill by the Atlantic Ore & Alloys Co. of Philadelphia, which has purchased the entire output of the mines. This company is to make an advance on ore of $20,000, which is to be used to erect the plant. Under the present plans the property will be operated with a prospective production of 5000 tons of concentrate annually; this will require the mining of 100 tons of ore per day. The ore, which is all under contract to the Government, will be shipped to Canto, Pittsburgh, and Jersey City.

Gold Hill, January 17.

UTAH

SUMMIT COUNTY

In a letter to the stockholders, Solon Spiro, president, and the directors of the Silver King Consolidated Mining Co., announce that the company has acquired the Ferry ranch, the Silver Bell, Oldham, and Russian Bear groups of mining claims, and the C.-C. Consolidated group of claims and mining and milling equipment. The California-Comstock group of mining claims has been acquired recently for $300,000, which has been paid, but to raise the necessary amount an indebtedness was incurred that will have to be paid during the present year. The president and directors recommend that the company should increase its capital to meet the indebtedness and provide funds for development and equipment. They are enthusiastic about the company's holdings in the Park City district.

WASHINGTON

SPOKANE COUNTY

The establishment of a large electrolytic antimony plant at Spokane is promised if further tests of such a process on ore are successful. Laboratory experiments on ore taken from the property of the Coeur d'Alene Antimony Mining Co. on Pine creek, Idaho, have encouraged the owners so much that M. E. Jolley, president of the company, says a small factory will be erected at once to continue the tests on a larger scale. It is

said buttons of metal containing 99% antimony have been obtained from the laboratory work.——During the past year 75 tons of high-grade ore has been mined and over 2000 tons of milling ore placed in the bins awaiting the flotation plant.

CANADA

BRITISH COLUMBIA

The annual report of the Consolidated Mining & Smelting Co. of Canada shows a production of metal to the value of $13,000,000 at a net profit of $1,076,828. Operations have been conducted at a considerable disadvantage; in the early part of the year strikes at the coal mines caused a shortage of coal, which necessitated the discontinuance of ore shipments from the Rossland mines and curtailment of shipments from the other properties, while toward the end of the year a strike of workmen at the smelter at Trail caused not only the closing of the smelter but of the company's mines. The electrolytic-zinc plant was completed during the year, and a daily production of 60 tons of pure zinc was reached. The total production of electrolytic lead was 22,000 tons, 2000 tons more than in the previous year. The capacity of the sulphuric-acid plant has been doubled, and two new retorts have been added to the hydrofluosilicic-acid plant. A new unit has been added to the Dwight-Lloyd roasting-plant in the lead works; and a flue-gas scrubber, a melting retort, and blue-stone vats were added to the silver refinery, while the furnace and casting facilities at the copper refinery were re-built and re-modeled.

At a meeting of the directors of the Utica Mines, held at the company's office at Spokane on January 12, the president was authorized to increase the capital stock from $2,000,000 to $$3,000,000 by the creation of 1,000,000 shares of capital stock, par value $1, fully paid and non-assessable, and to issue $200,-000 of first-mortgage bonds, according to an official announcement. The president also was authorized to negotiate for the purchase of the Sunset and Bell groups in Jackson basin for 800,000 shares of stock and $70,000 in cash. Of the proposed bonds $65,000 have been subscribed for in Spokane and British Columbia. The remaining $125,000 in bonds, or as much of the amount as is necessary to equip the properties, will be taken up by H. H. Armstead, his friends, and business associates in the East. As soon as the money is paid in from the sale of the first $100,000 in bonds, the Utica company will take over deeds to the Bell and Sunset group of mines, when 2,400,000 shares of the 3,000,000 shares will be issued and 600,000 shares will remain in the treasury. The company will own 18 full and fractional crown-granted claims, a mile square of timber-limit, and two water-power sites. There are nine known ore-shoots on the properties. The No. 7 adit on the Utica mine is now in 2000 ft. and will develop four ore-shoots to depths of 350 to 1600 ft. below the lower workings. These four shoots vary from 500 to 750 ft. in length and from a few inches to several feet in width. They contain a high-grade silver-lead ore averaging 150 to 250 oz. silver, 20% lead, and 17% zinc. The lower adit of the Sunset group, now in 1800 ft., will cut what is known as the west ore-shoot on the Sandon side of the mountain at 270 ft. below the lowest workings. This shoot of ore has yielded several hundred thousand dollars worth of silver-lead ore averaging 60% lead and 155 oz. silver. The Bell adit, driven from the Jackson Basin side, or the east side of the mountain, has developed the Bell zinc ore-shoot, which is 35 ft. wide at a depth of 100 ft. from the surface and when advanced will gain an additional depth of 100 ft. from the ore-shoot. The shipping ore averages 45% zinc and the whole 35 ft., 25% zinc. An adit has been driven westward from a point 250 ft. from the mouth of the Bell adit that should cut the east lead-silver ore-shoot on the Sunset vein 250 ft. below the lower workings. A 9-ft. body of silver-lead ore has been uncovered on the property of the Galena Farm Mining Co. in the Nelson mining district.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

L. C. Trent, of Los Angeles, is here.

George H. Sexton is here from New York.

Robert T. Kinzie has returned from Mexico.

Stuart H. Ingram has gone to Marysville, California.

Charles E. Pickett is in the 5th Field Artillery, U. S. Army.

George H. Garrey arrived in San Francisco this week from Philadelphia.

F. J. Strachan is now with the Cananea Copper Co. at Cananea, Sonora, Mexico.

George H. Hyde, of Ridgway, Pennsylvania, is on his way to Sacramento, California.

Charles Simenstad has opened an office as consulting engineer in L. C. Smith Bdg., Seattle.

J. Rowland Evans is visiting at Butte, after spending six years in the Belgian Congo, West Africa.

Daniel G. McLachlan is superintendent of the Armstead mines at Talache, on lake Pend Oreille, Idaho.

W. E. Thorne, for three years advisory engineer to the Lena Goldfields, in Siberia, has returned to San Francisco.

Percival P. Butler, formerly with the Copper Queen smelter, is now superintendent of the U. V. X. smelter, at Verde.

B. Magnus, now with the American Metal Co., at New York, is here on his way from Joplin, Missouri, to Trail, B. C.

W. H. Landers, Captain in the Engineer Reserve Corps, is now with the American Expeditionary Force in France.

E. G. Snedaker is First Lieutenant in the 4th Regiment of Engineers now stationed at Camp Greene, North Carolina.

E. G. Montgomery, superintendent for the Consolidated Mining & Smelting Co., at Rossland, has been examining mines near Hedley, B. C.

F. L. Ransome, of the U. S. Geological Survey, is in San Francisco, on his return from an inspection of the quicksilver mines of California.

W. Sinclair Brown, having resigned as chief metallurgist to the Redjang Lebong company in Sumatra, is returning to San Francisco early in March.

S. A. Lang, formerly with the Braden Copper Co., at Rancagua, Chile, has been given the commission of Lieutenant in the Canadian Engineers, C. E. F., and is at St. Johns, Quebec, Canada.

Obituary

Allmand A. Blow died at Knoxville, Tennessee, on January 2. We announce the fact with deep regret. On January 14 the Board of Trustees of the Colorado School of Mines passed a resolution stating: Resolved, That the Board of Trustees, the faculty, and the student body of the Colorado School of Mines place upon the records of the institution their marked appreciation of the deceased as a citizen of liberal education and wide usefulness, as a mining engineer who added greatly to the reputation and service of his profession in four continents and as a member of the Board of Trustees whose connection with the Colorado School of Mines was made prominent by that loyalty and earnestness of conviction which brought loyalty and conviction in his colleagues. As the originator of the great Yak tunnel in the Leadville district the name of Allmand A. Blow is impressed for all time upon the annals of Colorado mining, while his early publications under the auspices of the Colorado School of Mines, prepared the way for the present importance and value of the zinc-bearing ores in the Rocky Mountain States.

THE METAL MARKET



METAL PRICES

San Francisco, January 22

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.95
Antimony, cents per pound	16.00
Antimony (wholesale), cents per pound	14.75
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67½
Pig-lead, cents per pound	7.00— 8.00
Platinum, soft and hard metal, respectively, per ounce	108— 116
Quicksilver, per flask of 75 lb	$125
Spelter, cents per pound	10.00
Zinc-dust, cents per pound	20.00

ORE PRICES

San Francisco, January 22

Antimony, 45% metal, per unit	$1.00
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.70— 0.85
Magnesite, crude, per ton	$8.00—10.00

There is little demand for either calcined or crude magnesite.

Manganese: The Eastern manganese market continues fairly strong with $1 per unit Mn quoted on the basis of 48% material.

Tungsten, 60% WO_3, per unit	26.00

Tungsten ore remains firm.

Molybdenite, per unit MoS_2	$40.00—45.00

EASTERN METAL MARKET

(By wire from New York)

January 22.—Copper is quiet and unchanged at 23.50c. all week. Lead is dull and firm at 6.90 to 7c. Zinc is inactive and steady at 7.87c. all week. Platinum is higher at $108 for soft metal and $116 for hard.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending			
Jan.	16	89.62	Dec.	11	85.70
"	17	89.37	"	18	85.38
"	18	89.62	"	25	86.42
"	19	89.62	Jan.	1	86.62
"	20 Sunday		"	8	88.66
"	21	89.62	"	15	90.04
"	22	87.87	"	22	89.29

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	48.85	56.76	75.14	July	47.52	63.06	78.92
Feb.	48.45	56.74	77.54	Aug.	47.11	66.07	85.40
Mch.	50.61	57.89	74.13	Sept.	48.77	68.51	100.73
Apr.	50.25	64.37	72.51	Oct.	49.40	67.86	87.38
May	49.87	74.27	74.61	Nov.	51.88	71.60	85.97
June	49.03	65.04	76.44	Dec.	55.34	75.70	85.97

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending			
Jan.	16	23.50	Dec.	11	23.50
"	17	23.50	"	18	23.50
"	18	23.50	"	25	23.50
"	19	23.50	Jan.	1	23.50
"	20 Sunday		"	8	23.50
"	21	23.50	"	15	23.50
"	22	23.50	"	22	23.50

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	13.60	24.30	29.53	July	19.09	25.66	29.67
Feb.	14.38	26.62	34.57	Aug.	17.27	27.03	27.42
Mch.	14.80	26.65	36.00	Sept.	17.69	28.28	25.11
Apr.	16.64	28.02	33.16	Oct.	17.90	28.50	23.50
May	18.71	29.02	31.69	Nov.	18.88	31.95	23.50
June	19.75	27.47	32.57	Dec.	20.67	32.89	23.50

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending			
Jan.	16	7.87	Dec.	11	7.91
"	17	7.87	"	18	7.75
"	18	7.87	"	25	7.75
"	19	7.87	Jan.	1	7.87
"	20 Sunday		"	8	7.87
"	21	7.87	"	15	7.87
"	22	7.87	"	22	7.87

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	6.30	18.21	9.75	July	20.54	9.90	8.98
Feb.	9.05	19.99	10.45	Aug.	14.17	9.03	8.58
Mch.	8.40	18.40	10.78	Sept.	14.14	9.18	8.33
Apr.	9.78	18.62	10.20	Oct.	14.05	9.92	8.32
May	17.03	16.01	9.41	Nov.	17.20	11.81	7.76
June	22.20	12.85	9.63	Dec.	16.75	11.26	7.84

LEAD

Lead is quoted in cents per pound, New York delivery.

Date			Average week ending	
Jan.	16	6.90	Dec. 11	6.50
"	17	7.00	" 18	6.50
"	18	7.00	" 25	6.46
"	19	7.00	Jan. 1	6.50
"	20 Sunday		" 8	6.65
"	21	7.00	" 15	6.75
"	22	7.00	" 22	6.98

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	3.73	5.95	7.64	July	5.59	6.40	10.93
Feb.	3.83	6.23	9.01	Aug.	4.62	6.28	10.75
Mch.	4.04	7.20	10.07	Sept.	4.62	6.86	9.07
Apr.	4.21	7.70	9.38	Oct.	4.62	7.02	6.97
May	4.24	7.38	10.29	Nov.	5.15	7.07	6.38
June	5.75	6.88	11.74	Dec.	5.34	7.55	6.49

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Week ending		Week ending
Dec. 25	115.00	Jan. 8	130.00
Jan. 1	130.00	" 15	130.00
		" 22	125.00

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	51.90	222.00	81.00	July	95.00	81.20	102.00
Feb.	60.00	295.00	126.25	Aug.	93.75	74.50	115.00
Mch.	78.00	219.00	113.75	Sept.	91.00	75.00	112.00
Apr.	77.50	141.60	114.50	Oct.	92.90	78.20	102.00
May	75.00	90.00	104.00	Nov.	101.50	79.50	102.50
June	90.00	74.70	85.50	Dec.	123.00	80.00	117.42

TIN

Prices in New York, in cents per pound.

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	34.40	41.76	44.10	July	37.38	38.37	62.60
Feb.	37.23	42.60	51.47	Aug.	34.37	38.88	62.53
Mch.	48.76	50.50	54.27	Sept.	33.12	36.66	61.54
Apr.	48.25	51.49	55.63	Oct.	33.00	41.10	62.24
May	39.28	49.10	63.21	Nov.	39.50	44.12	74.18
June	40.26	42.07	61.93	Dec.	38.71	42.55	85.00

The Board of Managers of the New York Metal Exchange recently adopted a resolution amending the tin contract so that hereafter all tin contracts will be subject to this resolution which practically provides for immunity to the seller in case of force majeure and permits postponements of maturities in such event until the seller is able to comply with terms of the contract.

GOLD AND SILVER PRODUCTION OF THE UNITED STATES*

(Gold, value; silver, fine ounces)

	Gold		Silver	
	1916	1917	1916	1917
Alabama	$7.400	$4,200	.....	.....
Alaska	16,124,800	15,171,300	1,266,317	1,351,100
Arizona	4,092,800	5,533,800	6,680,252	8,183,200
California	21,980,400	20,815,900	1,936,910	1,989,800
Colorado	19,185,000	15,955,100	7,551,761	8,163,600
Georgia	20,400	6,000	.....	.....
Idaho	1,058,300	711,500	11,570,399	11,683,100
Illinois	.....	.....	5,782	3,300
Maryland	.....	100	153	1,100
Michigan	.....	.....	759,068	686,700
Missouri	.....	.....	128,860	21,100
Montana	4,328,400	3,756,500	14,046,054	13,711,100
Nevada	9,084,700	6,922,900	13,682,067	11,441,100
New Hampshire	.....	.....	935	.....
New Mexico	1,350,000	1,025,100	1,729,917	1,313,700
North Carolina	23,000	15,700	1,738	2,800
Oklahoma	.....	.....	606	.....
Oregon	1,901,500	1,677,400	221,887	215,700
South Carolina	300	1,100	.....	.....
South Dakota	7,471,700	7,392,600	210,100	191,100
Tennessee	5,700	5,300	93,837	99,300
Texas	500	900	664,319	583,200
Utah	3,859,000	3,620,300	13,545,802	14,315,300
Vermont	300	.....	1,964	400
Virginia	500	1,700	508	9,400
Washington	580,600	434,900	294,516	257,000
Wyoming	20,200	200	3,407	4,900
Continental U. S.	$91,075,500	$83,052,500	74,397,159	74,227,900
Philippines	1,514,200	1,404,000	17,643	16,600
Porto Rico	600	100	.....	.....
Totals	$92,590,300	$84,456,600	74,414,802	74,244,500

*As reported by the Directors of the U. S. Mint and the U. S. Geological Survey.

Eastern Metal Market

New York, January 16.

The markets continue quiet and featureless. The publication of estimates of the 1917 output of copper, zinc, and lead, has excited some interest.

Copper is quiet and unchanged.

Tin is scarce for spot delivery and nominal.

Lead is not in active demand, but it has advanced.

Zinc continues in poor demand, but its price is nearly stationary.

Antimony has gone to lower levels in a dull market.

Bad snowstorms have added to the serious congestion on the railroads and the result has been a decided lessening of steel-mill and blast-furnace output. In the Chicago district the total pig-iron output has been 30 to 40% of normal, with the steel production somewhat more. This curtailment in steel output may mean a tighter drawing of the lines against less essential industries in the distribution of mill products, thus diverting more labor to imperative Government needs. Some large inquiries for shell-steel for the British government have appeared, and also one for plates.

COPPER

The market is proceeding in an orderly manner under the extraordinary conditions imposed by Government control. With the usual processes of buying and selling and the attendant speculation removed, there is little news, and the market is featureless. A fair business is reported for both Government and other uses at the controlled price of 23.50c. per lb. for carload and larger lots, and at 24.67½c. for less than carloads. There seems to be an ample supply, with consumers receiving all they need, and with satisfaction quite general. The publication of the U. S. Geological Survey's report showing the 1917 output of refined copper in the United States to have exceeded all previous records has put a damper on agitation for an advance in the Government price from 23.50 to 25c. per lb. The total 1917 output is estimated at 2,362,000,000 lb., against 2,259,000,000 lb. in 1916 and 1,615,000,000 lb. in 1913. The only new feature of the week is the published unofficial statement that an agreement has been reached between the Government and the Copper Producers' Committee, assuring the maintenance of the 23.50c. price until May 1. It is asserted that an official statement from the President, expected every day, will confirm this rumor.

TIN

An important resolution was passed by the New York Metal Exchange on January 10, which places the burden of all risks, attendant on the unparalled shipping and railroad situation, on the buyer of tin, and it is probable that this will become a part of all contracts. During most of the past week, with the exception of yesterday, the market for futures has been active. Each day a good demand has appeared, which has resulted in considerable business. Delayed cables on one or two days seriously interfered with business. Yesterday the market was quiet. Spot tin of all kinds continues practically unobtainable, with quotations nominal at 85 to 86c., New York, for Straits. For Straits shipment from Singapore in March 69 to 69.50c. is quoted, with April shipment at 68.50 to 68.75c. Chinese No. 1, January shipment, is held at 62.25c., with February at 61.50c. England continues to hold up all shipments of Straits tin. Efforts here to change this have not resulted in success so far, though they are still progressing. Tin arrivals so far reported have been 460 tons, with 5500 tons reported afloat. Spot Straits in London yesterday was quoted at £299 10s. per ton against £282 on January 1.

LEAD

Another advance has been put into effect by the American Smelting & Refining Co. On Friday, January 11, it added ¼c. to its quotation, bringing it to 6.75c., New York. The outside market has also advanced to 6.90c., New York, or 6.75c., St. Louis. The trust's advance is the second in the last two weeks, the first one having been ¼c. on January 3. The reason for this is not clear to some, as it is not warranted by an active demand nor by a scarcity of lead. There is considerable speculation as to the real reason. The market as a whole is quiet but firm. Most of the consumers are not compelled to enter the market, and most of the sellers are not offering. One dealer has had metal in transport from the West since November, and has lost all trace of it. Transportation problems are serious, and are said to be as bad or worse than they were a year ago.

ZINC

The only interesting news of the week has been the estimates of the 1917 output of spelter. That of the U. S. Geological Survey puts last year's output at 667,751 tons, while other statisticians place it at about 18,000 tons higher, or 685,400 tons. The explanation of this variation is probably found in the fact that the latter computation includes secondary spelter redistilled at some large smelting plants. The interesting fact, however, is that the 1917 output was about the same as that for 1916, whereas it was generally expected, at least by those not actually on the inside, that a decided curtailment had taken place. These facts may explain the inactive or generally weak market that has existed for some time and that continues to exist. Prime Western for prompt or early delivery is quoted at 7.62½ to 7.75c., St. Louis, or 7.87½ to 8c., New York. Sales have been made at the lower levels, but the volume or importance is not consequential. Yesterday there were small sales for early February delivery at 7.75c., St. Louis, or 8c., New York, and it is stated that the tendency to scalping is not as marked as formerly. Stocks on hand or in transit at the end of 1917 were 50,107 tons, according to the Survey, and 60,000 tons according to other estimates. The surprising and significant fact is that these exceed those of a year ago by only 17,598 tons.

ANTIMONY

The market is lower, with spot metal duty paid, New York, quoted at 14 to 14.25c. One lot of 50 tons was sold a few days ago at 14c., New York, duty paid. An explanation of the poor demand for antimony is that anti-friction alloy makers have been producing at a low rate and consequently have been using less antimony. The possible Government order for 200 to 300 tons, referred to in a previous letter, is understood to have been placed.

ALUMINUM

The market is quiet with No. 1 virgin metal, 98 to 99% pure, quoted at 36 to 38c. per lb., New York, for prompt and early delivery. It is stated that the Government may fix the price of aluminum at a lower level than that of 38c. as the contract price of the leading producer. Some say that the 1918 output will be 35% larger than that for 1917.

ORES

Tungsten: The general railroad congestion has interfered with normal business. One dealer affirms that he has had ore for export on the way from the West for over two months, with vessel space twice engaged and cancelled. But little business in the week has been reported. Prices are nominal at $24 to $26 per unit in 60% concentrates, depending on the ore.

Book Reviews

A Treatise on the Elements of Electrical Engineering. A text-book for colleges and technical schools. By Wm. S. Franklin. Vol. 1. Pp. 465. Ill. Index. The Macmillan Company, New York, 1917. For sale by Mining and Scientific Press. Price, $4.50.

This is a companion to the work by the same author entitled 'Electric Lighting and Miscellaneous Applications of Electricity', which, as re-printed, will constitute Vol. 2 of 'The Elements of Electrical Engineering', thus making a very complete résumé of the essentials of practical electrical operations of the day. The present volume is divided into three parts, the first reviewing elementary and applied electricity and magnetism, which deals with ferro-magnetism and electro-magnetism, heating-effect of the electric current, induced electromotive force, the electric field, the electron theory, and other subjects. Part II deals with direct-current machines and systems, and plunges at once into the practical side of the question. Part III develops the elementary theory of the alternating-current, and Part IV deals with alternating-current machines and systems, including the alternator as a generator and as a motor, the conversion of alternating to direct-current, with problems and solutions, transformers, the induction-motor, the single-phase commutator-motor, and the general theory of transformers and induction-motors. While it deals with the simple physics of the subject, it must be stated that the use of the work requires a knowledge of calculus.

Heat. By John Roger. 12mo. Pp. 77. Publishers Printing Co., New York, 1917. Privately printed.

The thesis presented in this book may best be summed up in the preferatory words of the author. He says that "Heat is a diamagnetic or negative force acting in opposition to the positive force of atomic attraction; that temperature is the negative atomic stress produced between the atoms; that the work-value of a unit of heat is 778 foot pounds, but is proportionate to the temperature; that the unit of energy, 778 foot pounds, may apply anywhere on the scale of temperature without reference to the unit of heat; that there is no such thing as latent heat, but that there is only developed and undeveloped energy; that the properties of different forms of matter can be compared by quantities of equal weight, but that the specific heat of different materials should be dealt with by equal volumes." He further affirms that "Gases do not expand proportionately to their pressure per square inch, but when expanded adiabatically the pressure varies inversely as the square of the distance between the atoms." He distinguishes between a gas and a vapor by a difference in the intensity of the force of attraction between the atoms, and he points out that the specific heat of matter has no apparent relation to the atomic weights. Since this is the work of a trained and highly accomplished physicist and mathematician, who yet knows how to use language as an expression of mathematical ideas without resort to symbols, which is a rare mental qualification, it is certain that Mr. Roger's book will be demanded by a large and interested public.

Heaton's Annual, 490 pp., price $1.25, published by Heaton's Agency, Toronto. Of the new features we notice a list of titled and decorated Canadians, which the War has swelled to several pages, and under the heading of 'Commerce' is an interesting compilation of the pre-war imports from enemy countries into Canada, which will be a useful guide to firms considering the establishment of a new industry in the Dominion. At the end of the book a new section under the heading of 'Colonization' gives some interesting and valuable information that has not been collected before; here we find under each Province land available for farming; fruit farming; cattle and sheep ranching; crown land regulations; financial assistance given to farmers by Provincial and Dominion governments; and special provisions for returned soldiers.

The first part of the book contains the official directory; postal information; shipper's guide; commercial regulations; railway and steamship guide; and customs tariff. In the last half is a complete up-to-date summary of the resources of the Provinces including agriculture, canals and waterways, commerce, education, finance, fisheries, forests, fur farming, mining, and water-powers. This is followed by the official Boards of Trade Register giving descriptions of every commercial town in Canada with its industrial opportunities. References are given throughout the text to a section entitled 'Where to Find It.' This contains a guide to the more important Dominion and Provincial government reports and standard publications from which all available information on any subject can be obtained. Cross references are given to this section throughout the text.

Recent Publications

Bibliography of Recent Literature on Ore Flotation, July to December 1916. By D. A. Lyon, O. C. Ralston, F. B. Laney, and R. S. Lewis. Technical Paper 176. U. S. Bureau of Mines.

Annual Report of the San Francisco Polyclinic and Post Graduate College, 1917. 96 pp., ill.

Peat in 1916. By J. S. Turp. 2 pp. U. S. Geological Survey.

Boletin Minero, Organo del Departamento de Minas. 220 pp. Ill. Departamento de Talleres Graficos de la Secretaria de Fomento. Mexico, 1917.

The Resources of Tennessee. Vol. VIII, No. 3, 34 pp. Map. State Geological Survey, Nashville, Tennessee.

The Mineral Industries of the United States. Fertilizers, an Interpretation of the Situation in the United States. By Joseph E. Pogue. 22 pp. Ill. Bulletin 102, U. S. National Museums.

Hydraulic-Mining Debris in the Sierra Nevada. By Grove Karl Gilbert. 154 pp. Ill. U. S. Geological Survey.

On Thermo-Electric Heterogeneity in Certain Alloys, Especially German Silver. By E. H. Hall, L. L. Campbell, and S. B. Serviss. 21 pp. Proceedings of the American Academy of Arts and Sciences.

Compressibility of Natural Gas and Its Constituents With Analyses of Natural Gas From 31 Cities in the United States. By C. A. Burrell and J. W. Robertson. 16 pp. Ill. Technical Paper 158, Petroleum Technology No. 32, U. S. Bureau of Mines.

Suggestions for the Safe Operation of Gasoline Engines in Mines. By R. H. Kuddlish and Edwin Higgins. 19 pp., ill. Technical Paper 174, U. S. Bureau of Mines.

Seventh Annual Report by the Director of the Bureau of Mines to the Secretary of the Interior. 106 pp. U. S. Bureau of Mines.

Mines Statement for 1916. By L. S. McDonald, Minister of Mines for New Zealand. 96 pp., maps. New Zealand Department of Mines.

The Income Tax and Other Federal Taxes. By Joseph J. Scott. 354 pp. Kohuke Printing Co., San Francisco.

Announcement

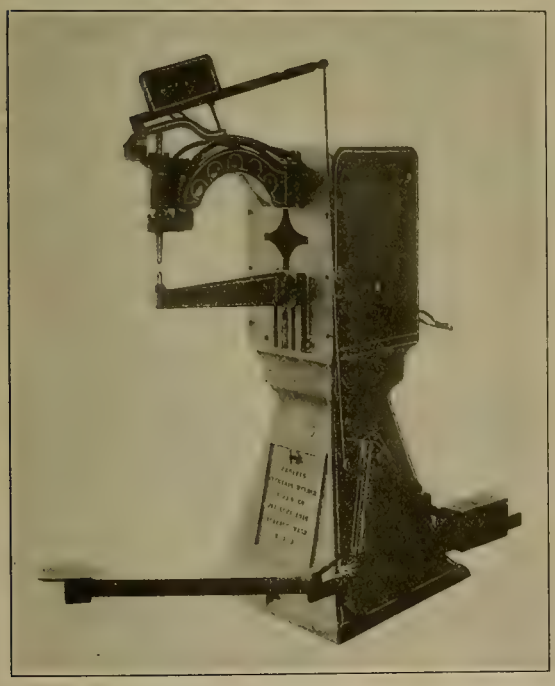
The Dean of the University of Illinois announces that twelve fellowships in research engineering and two in research gas engineering will become vacant at the end of the current academic year. These fellowships run for two years, carry an annual stipend of $500, and, if all requirements have been met, the degree of Master of Science will be conferred. Further particulars may be obtained from the Director, Engineering Experiment Station, University of Illinois, Urbana.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

PACIFIC ELECTRIC SPOT-WELDERS

Electric spot-welders, which are rapidly superseding the older methods of riveting iron, owing to their economy in material, time, and labor, are now being manufactured by the Pacific Electric Welder & Manufacturing Co. of Seattle, Washington. The company has many of its welders operating in various manufacturing establishments of the United States as well as in Japan and Australia. It is gratifying to note that this company has developed an important export business with Japan and Australia for the sale of its welders. The welders



PACIFIC ELECTRIC SPOT-WELDER TYPE S-A-10

are suitable for various classes of work in sheet metal and ornamental iron shops, stove manufacturers, shipyards, etc., and will readily be found an indispensable piece of machinery to manufacturers now engaged in riveting various articles of metal, owing to its great saving in time, labor, and material, as well as its current consumption being less than the cost of rivets.

The electric spot-welder is very simple in operation. It is the joining or fusing together electrically of two or more metal sheets or parts without any preparation of the stock used. Mechanically it is equivalent to riveting, but it is stronger and much quicker and more economical. By placing the materials between the electrodes or welding-points where it is desired to make a weld, then, by applying pressure either with the hand or foot-lever, the metals are pressed together, electrical contact is instantly made, and the weld is accomplished; wrought steel and galvanized iron are the best materials for electric welding.

Two standard types of various rating are manufactured by the company. One type is adapted to work on clear stock measuring 30 to 11 gauge, or welding a combined thickness of one-quarter inch, while the other is for 30 to 3-gauge materials, or a combined thickness of one-half inch. Special welders to meet the requirements of various classes of work can also be manufactured. The company has many letters from manufacturers now using the welders, which tell of their merits. The plant erected by the company is a substantial structure consisting of about 30,000 sq. ft. of floor-space, and, taking its present demand for the welder as a basis to judge, it is destined to become one of the leading manufacturers on the Pacific Coast.

BLASTING SOOT OUT OF A STACK

Sooty smokestacks are wasteful of fuel. A safe and economical way of cleaning them by the use of blasting-powder is suggested by the Du Pont magazine. For this purpose a 'gun' is used, made of an old piece of pipe-shafting about 4 in. diam. and 14 to 16 in. long. A hole 1¾ in. diam. and 10 in. long is bored in one end of this shafting, converting it into a small cannon-like arrangement, and a touch-hole ¼ in. diam. is bored through the side about 9 in. from the end, connecting with the centre bore and serving for the fuse. This gun is then mounted on a pedestal 6 in. diam. to hold it upright. The method of operation is as follows: Pour blasting-powder into the mouth of the cannon to about 2 in. from the top. Tamp to the collar with dry clay. A short piece of fuse is inserted in the touch-hole and in contact with the main powder-charge. Open the flue-door at the bottom of the stack, set the cannon on the bottom, and in the centre of the stack, light the fuse, and close the flue-door. The explosion shakes and loosens the soot adhering to the sides, causing it to fall to the bottom. It can then be removed through the flue-opening. A charge of 8 in. of FFF powder, 1¾ in. diam., is sufficient for a stack up to 100 ft. high and 4 ft. diam., or over. The number of shots necessary to thoroughly clean a stack depends upon its condition. Ordinarily three or four shots will be sufficient, but if very dirty it may require more. The size of the charge and length of the cannon can be regulated to suit the height and diameter of the stack. There is no doubt as to the efficiency of this 'gun' for cleaning smokestacks. One of the largest manufacturing concerns in the country has used this method for several years without an accident or injury in any way to the stacks.

FOREIGN TRADE CONVENTION

The National Trade Council will hold its 5th National Foreign Trade Convention at Cincinnati on February 7, 8, and 9. The chairman of the Council is James A. Farrell, president of the United States Steel Corporation, and the chairman

of the local Cincinnati committee is Robert S. Alter, vice-president of the American Tool Works Co. The chairman of the physical arrangements committee is A. B. Fishwick, 812 Commercial Tribune Bdg. In his call for the convention Mr. Farrell says:

"American participation in the war against Germany has laid a new obligation upon the foreign trade enterprise of the United States. To give serious thought to the demands and problems of the future, delegates from every part of the United States, representing all phases of commercial and civic development, will assemble for the three days' session at Cincinnati. It is our duty, as never before, to see that the flow of overseas commerce proceeds with uninterrupted regularity and in the largest possible volume, steadily bringing to us the products necessary to the enterprise on which we are embarked, and steadily carrying to our Allies, the materials and manufactures that will enable them to maintain their efforts." It is an appropriate moment for serious men to discuss the larger aspects of future trade in the light of possible plans for a world-peace. The world will not relapse into the old accustomed groove. Men who think in terms of the old ways of conducting business simply are not thinking. We may talk of foreign credit, which is one of the subjects to be discussed at the convention, but no man can present a sound view of future credit-relations without considering at the same time the basis on which trade between the nations may be re-established after the War. That is to bring up the whole issue of war-aims. If we have reached a dogged determination to eliminate Teutonic power as a unit-factor in world-affairs then we can rehabilitate the family of nations on the broad secure foundation of national trade and amity if we so desire.

TRADE-MARKED SUPPLIES

When, after thorough investigation, an engineer or architect is convinced that a certain article or material is exactly suited to the needs of his clients it would seem that he should say so without hesitation or further discussion. To specify what is right, 'or equal', in the first place discredits the engineer's judgment and experience and is a tacit admission that he may have committed a technical error in specifying a particular article. From the time this iniquitous clause is made public until construction is practically complete it is important to keep within the spirit of the specifications. He must use his own judgment as to a possible substitute just as he presumably did when first drawing up the specifications. After such reflection, the old excuse that the 'or equal' clause is inserted to give others a chance and to prevent charges of favoritism loses its potency. Such accusations are as old as tradition, and should have no weight where motives are just and sincere. When a reputable doctor prescribes a given drug under given conditions no one thinks of charging him with partiality toward its manufacturer. But when a certain article or material has been selected, how is the inspector to know that no substitution has been made by an unscrupulous contractor or dealer? In these days of clever imitation even the most experienced superintendent may be readily deceived by mere casual inspection, and exhaustive tests of each item during construction are impracticable. The only satisfactory answer to the dilemma seems to be the exclusive use of trade-marked material, or materials which are clearly marked as to quality or grade by the manufacturers. An article that is not good enough to be trade-marked, or bear evidence of grade backed by the maker, is not good enough to specify. Aggressive manufacturers in nearly all lines of trade have found some method of distinguishing their products and thus have accomplished what might be termed four-fold protection. By preventing substitution of another article for that of their own manufacure, they assure to themselves the full benefit of their extensive advertising, they assure to the consumer the satisfaction for which he is paying, they assure to the engineer certainty and ease of identification, and they assure to the contractor and dealer freedom from possible charges of dishonesty. —Abstract: 'American Architect.'

COMMERCIAL PARAGRAPHS

The Smooth-On Manufacturing Co. has just issued a booklet entitled 'Extracts from Instruction Book,' No. 16, showing the application of 'Smooth-On' for mending breaks of water-pipe subject to high pressure, as well as the use of this valuable material in making tight joints, surfacing concrete floors where heavy traffic is to be resisted, and in filling open joints in iron and steel work where a material that is hard and non-shrinkable is required.

'Protective paint costs less than rust-catastrophe,' is a saying of the Joseph Dixon Crucible Co. In 'Graphite,' the organ of the house, in the November issue, is illustrated the viaduct of the Fort Smith Light & Traction Co. at Van Buren, Arkansas, painted in 1914 with Dixon's silica-graphite paint. The paint is still in good condition, despite the fact that the structure spans railroad tracks and is subject to severe conditions of smoke, heat, dust, and abrasion.

'Everything for Mine and Industrial Safety' is the title of an elaborate catalogue issued by the Mine Safety Appliances Co. of Pittsburgh. It gives in detail the description of first-aid equipment and supplies, according to the latest practice, with specifications for ordering, and prices. Among other appliances illustrated and described are portable electric mine lamps, gas detectors, the 'Fleuss Proto' self-contained oxygen breathing-apparatus for mine-rescue work, ammonia masks, shot-firing batteries, the Johns-Manville fire extinguisher, post-pullers, anemometers, water-gauges, hygrometers, safety ladder-shoes, horse-shoe magnets, mine telephones, and signal apparatus, the Davis flood-light, oxygen cylinders, and a large number of other appliances which are in growing demand with the spread of the propaganda for increased safety.

The first death among the 1624 employees of the B. F. Goodrich Rubber Co. that have enlisted since the outbreak of hostilities is that of Ensign P. W. Page. He was particularly well known in the Eastern automobile field. Ensign Page was drowned off the coast of England, according to word reaching the tire corporation, when his sea-plane became unmanageable and plunged into the sea. He has been in the service of the United States since May 4. He had been in the employ of the Goodrich company since September 3, 1913. He came to them from Harvard University. He had always been interested in aviation, and during his college days made many flights. He remained at Akron until March 10, 1914, when he was transferred to the Cincinnati branch, working from that point as a traveling representative until April 1, 1915, when he became manager of the Portland, Maine, branch. On March 6, 1916, he was called to the Boston branch, and was assigned to cover western Massachusetts and southern Vermont. Shortly after the outbreak of war he resigned to enter the naval branch as an aviator. Officials of the Goodrich company deeply regret his death. He possessed an enviable reputation as a man and as a representative of the organization.

Stephen G. Murray, for many years general Western representative of the Ingersoll-Rand Co., died in San Francisco on Sunday, January 6, at the age of 64 years. Mr. Murray had been in the service of the Ingersoll-Rand Co. and its predecessor, the Ingersoll Sergeant Drill Co., for over 30 years. He had, for the last 20 years, spent most of his time in the West, particularly in San Francisco, Salt Lake City, Butte, Seattle, and Juneau, where his many friends will learn with regret of his death. He leaves a widow.

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Further information will be promptly supplied by the

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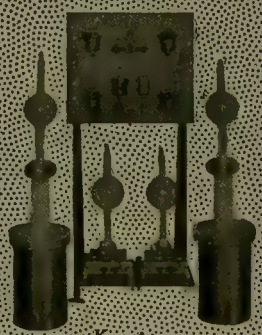
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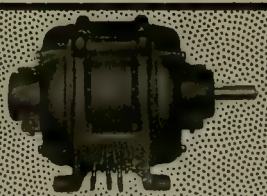
Kenotron Equipment



Potential Regulator and Panel. Can be used in place of low tension transformer taps



Motor Generator Set Energizes Transformer



Synchronous Motor for Rectifying Switch. Not used with Kenotron equipment or motor generator set



FLOTATION litigation will be expedited by the hearing of the case of Minerals Separation *v.* Butte & Superior, which comes up on appeal before the Ninth Circuit Court of Appeals, in San Francisco, on March 8.

WE publish an interesting article describing the use of ordinary sea-water as a frothing-agent, a recovery of 92.88% of copper being obtained on a chalcopyrite ore. Our readers are aware that patents involving the use of alkaline chlorides have been granted to Messrs. F. J. Lyster, Leslie Bradford, and others. All of these patents, we believe, have been acquired by Minerals Separation. The question arises, can you prevent a man living at tide-water from using the ocean or a man in the interior from employing the waters of a saline lake in his metallurgical operations?

GREAT BRITAIN has just signed a new treaty of commerce with Spain, after many months of negotiation, whereby Great Britain is entitled to draw from Spain all the iron ore and pyrite that she can obtain by operating mines, or by purchase in the open market, in exchange for the right to import into Spain 150,000 tons of British coal, 300 tons of tin-plate, and 120 tons of ferro-manganese per month. The treaty has reference also to exchanges of food-products. The Spanish newspapers express dissatisfaction over the failure to secure the right to purchase ammonium sulphate from England, but it is apparent that no nitrogenous products could be spared during the War. Spain must have recourse to by-product coking of the coal from her rapidly developing mines for a domestic source of ammonia. In so doing she will benefit her own people.

ZINC mining has suffered from a spasmodic market, which just now looks sickly. Probably one-third of the spelter plants are idle, owing to the low price of the metal. The New Jersey Zinc and the American Metal companies are producing one-fifth apiece of the total output. At a price of $17 for roasting and distillation of a 40% concentrate, on an 84% recovery, the cost is 2.6 cents per pound. The refining costs 1½c., but only 40 to 45% of the retort-product has to be re-distilled, so that 0.5c. covers that item. A 60% concentrate is purchasable for $54. Allowing for a recovery of 1000 lb. of zinc, the cost is 5.4c. per pound; but $12 to $13 per ton of concentrate must be credited for the sulphuric acid that is made as a by-product, so that the purchase price is reduced to $41.50, making the cost of the zinc 4.15c., which, added to the cost of treatment, makes 7.25c. as the total. This would give the smelter a margin of 0.62c. on the current quotation. The miner, at Joplin, for example, that sells his concentrate for $54 is making from $5 to $10 per ton on a 50% concentrate, or about 0.75c. per pound of zinc. On the face of it the miner and the smelter are dividing a profit of about 1½c. per pound, but we suspect that the smelter holds the longer end of the stick. Several weeks ago we referred to the peculiar difficulties that have beset the zinc industry since our declaration of war. The needs of the Government for copper were ascertainable, and a fair price was established, but no indication was given as to the probable war-demand for zinc. The producers have now held a conference with the Council of National Defense, urging Government action to stabilize prices. In the interest both of conservation and preparedness an official forecast would seem desirable, in order that zinc mining be regulated on an economical basis.

OUR contemporary at New York publishes two obituary notices, of A. A. Blow and William Hague, that will be read with sympathetic appreciation. These two friends of ours were not among the notorieties created by a cheap press and predatory finance, but professional men of the highest character, in whom technical ability and intelligent initiative were joined with those higher qualities that make a man a good husband and father first and then a good citizen. In age nearly a generation apart they were guided alike by those high principles and the love of doing work for the sake of doing it well that distinguish the professional man from the mere laborer. Blow proved himself a forceful and capable engineer at Leadville before he went to South Africa, where, as manager of the celebrated Sheba mine, he did honor to the American branch of the profession, both as technician in designing a mill and as director of a large force of Kaffirs. His two stalwart sons, one of them in the Army, will perpetuate a tradition of good citizenship. Hague went into military training before war was declared by the United States, so that he was ready, as

well as willing, to volunteer instantly for military service when the call came. His example led 54 men at the North Star mine, at Grass Valley, to enlist. While at American Lake he caught a severe cold, from which he had not recovered when about to start for France. None of us, however, was prepared for the news of his death by bronchial pneumonia. At the last meeting of the local section of the Institute several members took the opportunity to pay a tribute to his memory. He was the worthy son of a good and useful man; like him, an engineer and a gentleman; a straight, clean, strong character. His influence will remain and his memory will be one of the fair things left from the wrack of warfare.

UNDER the collective name of 'Scientific Nominalism', Mr. Dudley Norris presents a formidable array of words and phrases that have been used in published attempts to explain in scientific fashion how the phenomena of flotation are caused by electricity; and by his philosophic examination of these words and phrases he undertakes to prove that they are names and nothing more. In his review of the flotation litigation Mr. Norris credits Minerals Separation with the invention of agitation to form a froth, stating that it was the result of a capricious acceleration of the Gabbett mixer to an abnormal degree to see what would happen. We impute the origin of froth-flotation to the work done in the Central mill, at Broken Hill, in 1903 and 1904. Aside from this one feature Mr. Norris denies any further invention by Minerals Separation, and credits Mr. Ballantyne, Mr. Ballot's patent lawyer, with having adapted from the Elmores, with whose work Mr. Ballantyne was familiar, the diminished proportion of oil and other features of the Minerals Separation patents. He considers that Mr. Ballantyne's specification and claims were drawn with a technical skill conspicuously absent from those of the infringing defendants. The latter undertook to supply the deficiencies in their patents by numerous and elaborate physical tests and scientific demonstrations of the various processes, but unfortunately for them they met with a judicial psychological condition that militated against their best efforts. Mr. Norris shows the development of the inductive and the deductive systems of logic in ancient Greece, and suggests that the legal profession, including the judges on the bench, are trained in deduction to the exclusion of induction, which is the method of the physical sciences, with the result that even Aristotle, the father of deductive logic, was intellectually color-blind in the presence of the problem of the falling bodies, his decision that the larger body would fall the faster remaining unchallenged for centuries until Galileo, the champion of induction, proved its fallacious character. We accept the pleasant lucubrations of Mr. Norris as making for the dissipation of fog and an increase of good-natured sanity. Another generation will laugh at the pretensions of Minerals Separation, which could not explain the physics of the invention it claimed to have made, though it will be less easy to forgive than the nomalistic errors of Heraclitus, who really did grasp a great truth when he conceived all that exists as a perpetual becoming, and its progress the conversion of state as expressed in 'fire'. He recognized the germ-principle of the eternal forward movement, which Bergson has so splendidly adapted to the modern view-point in the light of biologic revelations.

NEWS is not coming out of Mexico these days as freely as it did when the opposing factions were fighting each other through the American newspapers as a means of gaining help for their military struggles. Carranza has been maintaining a news bureau that is not altogether clever, since the stories of progress and development issued to the public are too extraordinary to be credited by men of understanding. Meanwhile, information of quite another order filters steadily through the screen of censorship along the border. We hear of a serious clash between Carranza and the Congress over his bill for a single bank of issue, based upon imaginary assets. It was a wild scheme, and so certain to destroy what little credit Mexico had regained by her salutary return to metallic currency that the Congress, in order to escape official brow-beating, adjourned. Carranza retaliated by holding up the treasury warrants of the deputies for salary and mileage. This act evidently brought reprisals, for we hear of Carranza's sudden departure for Queretaro, where he has prudently remained for several weeks. Rumors of new revolutionary enterprises are rife, and even 'Las Novedades,' the faithful advocate of Carrancism in this country, admits that trouble is brewing, and that two of Carranza's generals, Francisco Coss and Luis Gutierrez, heretofore counted among the strongest adherents of the Government, have taken up arms in opposition. Obregon appears to have definitely 'retired,' whatever that may mean or may signify. On the other hand, Carranza finds cause for congratulation over the utter collapse of the revolution started by General Juan A. Almazan in Nuevo Leon, that campaign having failed to enlist the sympathy and support of the anti-Carrancistas. Private information from numerous travelers returning from Mexico leads to the conviction that no such thing as law and order exists, and that the policing of any district and the quality of justice meted out depend entirely upon the personality of the local authorities. Even in the Persia of Hajji Baba there was sometimes to be found a measure of humanity and fair-dealing, mixed with an official eye to personal pecuniary advantage, that would enable a clever man to attend to business without being denounced to the cadi. It would be good to believe that Señor Garcia Vigil was voicing a changed spirit on the part of Mexico, and that he was speaking for his fellow deputies the other day in the Mexican congress when he announced that the proper place for his countrymen was at the side of the United States in this world-war, as an evidence of gratitude to President Wilson for having lent his potent aid to the Carrancistas, without which they never could have

triumphed. The spread of such sentiments would indicate the dawn of reason, which would speedily terminate the scandalous condition that now embarrasses the friendly relations between the two countries when every German spy, on being hotly pressed by our detectives, escapes to Mexico, where he seems to count on a cordial welcome and on liberty to continue safely to plot against the United States.

THOSE who have been complaining about conspicuous incompetence at Washington may congratulate themselves. The protests they have made have caused the Administration to do the obviously practical thing that should have been done last April. We refer to the appointment of Mr. Edward R. Stettinius as surveyor-general of Army purchases. The title may be somewhat vague, and it was apparently meant to be; nevertheless the critics who have seized upon this matter of mere nomenclature as indicating a purpose to retain the old order are likely to be surprised. Incompetence had been so fully demonstrated that the Administration either had to take refuge in the appointment of an acceptable administrator of purchases, or enter into a bitter struggle with Congress over the creation of a special triumvirate or 'war cabinet.' An administrator of purchases was manifestly the less embarrassing of these alternatives, and the choice fell happily upon the logical man for the position. Mr. Stettinius has a reputation for success behind him that is too valuable to be put in jeopardy. He will be no figurehead; he will organize the work on a basis of efficiency or he will resign. The entire country has applauded the appointment; the incumbent will be given a free hand because the Administration dare not let him retire; to suffer that would be a more damaging criticism than anything Mr. Roosevelt or Mr. Chamberlain has said. It is a pity that the President should have waited so long before taking this step. The well informed were amazed that no advantage was taken of the great organization that had been created by J. P. Morgan & Company, under the immediate direction of Mr. Stettinius, to purchase war supplies for England and France. Here was a body of capable business men possessed of invaluable experience in buying, assembling, and shipping munitions and materials for war; they had performed this service so well that they possessed the implicit confidence of the governments whom they served as agents; they knew the sources of every commodity needed; they were intimately acquainted with the capacities of a multitude of manufacturing plants, and were familiar with the capabilities of the men controlling them. They were fitted to expand their organization to cope with the enlarged responsibilities of supplying our own Government in the crisis of war. It was almost unbelievable that the Administration would fail to commandeer this splendid organization, but the opportunity was ignored. A vain and muddled effort was made to form a new organization. The whole immense responsibility of placing orders for ourselves and the Allies was assumed by the Government without calling upon these tried specialists for advice. Confusion, delay, and economic waste have been the result. Self-sufficiency cannot successfully replace efficiency; therefore it is cause for thankfulness that the light has dawned at last upon official Washington.

Mining in Russia

Russian misrule does not appear to have affected the Kyshtim, Tanalyk, and Irtysh corporations as much as might have been feared. These large and important mining enterprises, in the hands of English and American engineers and capitalists, have survived the effects of the revolution because the actual mining and smelting operations are in Siberia, far from the centres of political ferment, and also because the Anglo-American directorates in London co-operate on the most friendly terms with the local Russian managements. The ore-reserve of the Irtysh Corporation, operating the Ridder and other zinc-lead mines in the Altai, is stated to represent $65,000,000 in probable profit. A discovery of 30-dwt. gold ore, 200 feet wide, is said to have been made recently on the 140-foot level of the Sokolni mine belonging to this corporation. The Tanalyk is said officially to have $12,500,000 profit assured. The Kyshtim produces from 6000 to 8000 tons of copper per annum and has large resources of ore. At the recent annual meetings of these companies it was announced that the shares in the Russian companies, which are the operating units as against the English holding companies, are now vested in the Russo-Canadian Development Corporation, with a view to prevent the transfer of stock to inimical interests. Whether the selection of this Canadian company was influenced by the expectation of evading taxation in England is not clear. The administration of the combined business will be in the hands of 15 trustees, among whom we recognize the following American mining engineers: R. Gilman Brown, T. J. Jones, and D. P. Mitchell. These have worked loyally, for many years, with Mr. Leslie Urquhart, the originator of these Anglo-American enterprises, a man whose unusual sagacity and energy have been aided by the fact that he was born in Russia and understands the people of the country. It appears that, by purchasing large stocks of food, boots, and other essential commodities, these companies have been able to take care of their work-people and to retain their goodwill, despite the efforts of the Bolshevik element to make trouble. Another obstacle to strikes and disorder lies in the fact that these mines are in parts of Siberia where the Bashkir and Kirghiz tribes of Turcomans predominate, and where the more nearly Russian element is represented by the Cossacks—all three peoples possessing hereditary rights and private ownerships that are menaced by the "socialistic ravings of madmen and the greed of the landless proletariat of the towns," as expressed by Mr. Cater Scott, the chairman of the Kyshtim Corporation.

The community lands of the Bashkirs and the Cossack lands of Orenburg serve as barriers to the encroachment of the I. W. W. element that has turned the revolution into a national collapse. At the same time these foreign companies appear to have conducted their operations in such a way as to have won the solid support of the local Russian managements, particularly of the technical staffs, so that, in the crisis of their fate, they were protected from harm. One cannot forbear admiring the good sense and sound policy responsible for this fortunate result. The chairmen presiding at the three meetings united in expressing confidence that the repudiation of contracts, expropriation of land, and anarchistic theories of the wild men at Petrograd will not be supported by the peoples of Siberia—the Kirghiz, Bashkir, and Cossack—and that before long the government of Russia will pass into sane and capable hands.

Copper Prices

It is claimed, at Boston, that the advance in the cost of the labor and supplies used in copper mining has increased the cost of producing the metal 1½ cents per pound during the last four months, and that therefore the War Industries Board would have been justified in advancing the price to 25 cents. It is estimated, again among speculators in copper shares at Boston, that between 50 and 75 million pounds of copper per annum "is being produced today by mines which cannot do more than break even at 23½ cents." Nevertheless, as our New York correspondent remarked, the argument for an advance to 25 cents was injured by the record-breaking production of copper last year in the face of an official price of 23½ cents. Assuredly the price should be fixed at a figure that will encourage the production of all the copper required for the purpose of the War, besides that which is required for domestic consumption of an essential kind. Speaking of the price of copper, the average of the averages given weekly on our market page during 1917 was 27.52 cents. The 'Engineering & Mining Journal' makes it 27.18. The 'American Metal Market' places it at 29.26½. We have good reason to believe that our average is nearly correct, as nearly correct as any calculation in which all the factors are not known and cannot be known. Our contemporary at New York poses as the last word in this matter, and has succeeded in persuading many copper dealers, particularly the buyers, that its guess is inspired. Nobody living is able to obtain a record of all the sales, giving quantity and price, and therefore nobody is able to give an accurate average. Even if the quantities and prices of all copper sales were known, as they never are, the average deduced therefrom would be incorrect, because the metal may be sold for spot, early, or late delivery, that is, the completion of the sale may take place at once or months hence. Sometimes, when the metal is scarce and prices are rising, there is no 'spot' copper available; at other times the supply is so good that forward sales are relatively unimportant. The natural operation of the laws of supply and demand is checked or obscured by speculators, whose dealings are not known to the statisticians. Different producers obtain different prices for copper of the same quality, for we refer to electrolytic only. For instance, the Phelps-Dodge Corporation received an average of 16.05 cents per pound for its copper in 1915, as against the 'Engineering & Mining Journal' average that year of 17.27, a difference of 1.22 cents per pound. In 1916, the Nevada Consolidated averaged 25.83 cents for its copper, whereas the Utah Copper obtained 26.139 cents, and in the same year the Chino and Ray obtained 26.465 and 26.724 cents, respectively, for their copper. This suggests that the selling agency made a useful profit out of the Nevada Consolidated business. Why anybody should make settlement on the guess of an individual is not obvious, particularly when a surer basis of settlement is available. The miner employed by the Blank company allows his wages to be determined by the price of copper as guessed by an individual, by no means omniscient, at New York or Boston, when he could just as well take the price at which the copper of the Blank mine is actually sold, for sales are made usually 90 days in advance of production—sometimes 180 days in advance. He can take a fact, instead of a guess, as the basis of the calculation on which wages are determined. Similarly the mine-owner should drop the silly custom of settling with the smelter on the guess of any technical or trade paper; let him settle on the price that the smelter gets. Here again there is no difficulty, for the smelter sells its product at least 90 days in advance, and is able therefore to state exactly what price it is receiving. The time will come, we venture to predict, when these and other anomalies will be rectified. For example, we have received a copy of the report by the Smelter and Ore Sales Investigation Committee in Colorado. This committee was appointed by the State legislature to investigate "all matters connected with the purchase and sale and marketing of metalliferous ores," besides other subsidiary matters. Even the appointment of this committee had a salutary effect on the smelter trust, otherwise known as the American Smelting & Refining Company, which made several changes in its schedules by way of placating public sentiment. The existing schedules are needlessly complicated; they represent the efforts of the smelters to protect themselves under metallurgical and economic conditions that have changed from the time when the bases of settlement were first devised. The Committee came to the conclusion that "no schedule based upon the unit and quotation system will ever be satisfactory to the producer." It affords too many chances for hanky-panky. The Committee believed that the selection of umpire assayers by the smelters was open to objection, and suggested some system of licensing umpires. In the report will be found a number of interesting charts prepared by Mr. O. R. Whitaker, on whom the major portion of the work of inquiry devolved.



Heap-Leaching of Copper Sulphide Ore

The Editor:

Sir—I am writing you in reference to an article on this subject by Mr. Courtenay De Kalb in your issue of November 24, 1917.

Through a misunderstanding in writing the article the impression will be gathered that Mr. Irving is entirely responsible for the work being done, in fact it is expressly stated that "the details whereby the system is made adaptable to American conditions have been evolved by Joseph Irving, who is in charge of the operations at Bisbee." Mr. Irving is locally in charge of the part of this work now being done at Bisbee, but will not, I believe, make any such broad claim to the entire credit for the idea or for the evolving of the details to make it adaptable to American conditions, as might be inferred from the article. A. W. Hudson is in local charge of large-scale tests to be carried on at Tyrone, and in view of the above, I am perfectly willing, as is just, to share with Mr. Irving and Mr. Hudson, in view of their cooperation in this work, any credit due if these tests prove successful or the responsibility for the expenditure of considerable sums of money if the reverse prove true, but I feel justified in being unwilling to do more than share such credit or responsibility.

With apologies to your readers for any space devoted to the above purely personal matter, but which I think is due me, I would like to call attention to a few points in the article which I think require correction. A considerable part of the descriptive matter, and of the pictures and sketches in the article, refers to our Bisbee mine-water treating plant, which was in operation long before this kind of leaching treatment was considered, and which will be operated irrespective of the results of any leaching work done hereafter. The leaching experiments are connected with this plant only incidentally. The plant was not designed with a view to any leaching tests, and its main function has not been and is not now in connection with leaching but with the treatment of mine-water. Exception must be taken to the statement in the article that the process, as now conducted, has demonstrated a recovery of 80% of the copper in the ore at the costs given. The fact is that to date we have obtained a recovery of only about 27% of the total copper originally laid down. I feel that the results so far are sufficiently encouraging to hope for ultimate success, but I certainly do not feel warranted in saying that we have demonstrated either anything like a fairly complete recovery or that our large-scale operating costs, if successful, will be those given. It is, of course, evident that, for either economy or even metallurgical success, in a matter of this sort, there must be careful experimental determination so far as possible of all the factors entering into the problem. These factors, as applied to Burro Mountain ore directly, and which will also be broadly applicable at Bisbee, are to be worked out by large-scale experiments which will be started in the near future at Tyrone. We anticipate several years before definite conclusions can be reached, owing to the unavoidably slow conditions of the tests, and do not feel that any definite statement as to construction, extraction, or costs can be made until the conclusion of these tests. On page 750 of Mr. De Kalb's article he states "experiments in precipitation were conducted on the mine-water for a period of nearly three years before 'heap-leaching' was tried. The possibility of economically reducing the ferric to ferrous salts by the use of Mr. Irving's pyrite filter was thus proved, and this paved the way for successfully treating the low-grade sulphides developed by drilling the disseminated granite porphyry ore on Sacramento hill." As a matter of fact this mine-water treating plant was in no sense experimental in character, but simply replaced the old and inconveniently located mine-water precipitation plant, which had been operated for years. Mr. Irving is entitled to credit for the actual installation of a pyrite-filter in connection with the treatment of this mine-water, but this pyrite-filter treatment was of course well known to every one familiar with leaching, and in no sense did its use "pave the way for successfully treating" these ores. As a matter of fact, it is now used only for the treatment of mine-water, and it is not now nor has it been used for the treatment of liquors from the heap. The statement made that this filter provides acid which maintains a 'sweet' condition of liquor in the precipitating-tanks is, I think, an assumption based on one of the equations that may be written to explain the reaction. These are extremely complicated, and very few of them have been definitely proved, and as a matter of fact I believe it will be difficult to show that the effective acidity will be any different for liquor after passing the filter than before. Under the proper conditions its use is of course well known to be advantageous, but I do not think we know enough of the chemistry of its action to say certainly what the reason for any favorable action is or to be able to write one equation which represents this action. As stated above, a distinction should be made between that part of

Mr. De Kalb's article describing the Bisbee mine-water treating plant and the leaching tests. Naturally this treating plant designed for quite another purpose will materially differ from that to be finally adopted if the experiments are successful. The description in the article of the work of the plant gives a good idea of this as it is, but the liquor from the heaps is not kept separate and therefore, since the mine-water is by far the greatest bulk treated, it will not be safe to apply the results from this without further tests to the design of a precipitating plant for liquor and conditions of an entirely different character. There are a great many inter-related factors which we have not yet made sure of: strength of solution in both ferrous and ferric iron, the effects of acidity, and of other possible constituents of the liquors, the depth of heap, the method of watering, interval for drying, size of ore, method of piling and of the making of foundation, of drains, and of waterproofing, all of which together with others will have to be worked out separately and in their relation to each other before a plant for this sort of treatment can be laid out with any degree of assurance of success.

The principal factor which we are now not sure of is the resistance of the ore to disintegration. If the ore crumbles by the action of the method to a slime, or even if any considerable part of it does, then percolation of the heap by solution and the solution of the copper will be so retarded that the method probably cannot be worked out for any practical depth of heap. It is only necessary to figure the amount of ground-space needed to treat eventually any considerable tonnage coming forward each day to see that the depth of heap and the possible thickness through which percolation can be done for a period of probably three or four years constitute the main deciding factors for or against the method. Many of the above factors evidently will have a bearing on the matter, and it is to settle as far as possible, systematically and thoroughly, the problems involved, that experimental work is to be carried on at Tyrone, which is to be under the local charge of Mr. Hudson, my former head-assistant in the leaching work at Douglas.

It is, I think, also safe to say that unless a method of precipitation can be devised that will do away with the very considerable labor charge for this operation it will be doubtful if the method can be applied to as low-grade ores as desired. Roughly speaking, copper from the cementation plant at Bisbee in the past has cost something like 2c. for iron and 2c. for labor, although, under exceptionally favorable circumstances, this has at times been reduced to nearly 3c. total. This is not an average, however, and it is safe to say that the average precipitation-cost for iron and labor under good conditions of the cement-copper plant treating mine-water has not been less than 4 cents. It is evident therefore that one of the main objects of the experimental work at Tyrone is to determine the utmost possible reduction of this precipitation cost. It should also be noted that the treating plant described in the article is designed for the accommodation of scrap-iron of various kinds, together with tin-cans. Assuming that the final experiments show that the method can be expected to be successful, it is only necessary to figure the amount of heaps, meaning the daily addition and removal of, say, 2500 or more tons of ore to see that scrap-iron is utterly out of the question as a precipitating material. Accordingly the questions of what kind and form of iron shall be used, its commercial availability, source, and relative economy become important problems. In other words, looking at the matter superficially, it appears to be an extremely simple proposition to put some ore in a pile, pump some water over it, and precipitate the resulting copper on iron. As soon as it is studied, however, it is evident that, for any commercial scale, it is a complicated chemical and engineering problem of quite the first rank. I do not therefore think it is safe to say, as the article states, that, in the new plant that will be built to handle the solutions from heap-leaching on a large scale when treating the Sacramento Hill low-grade ores, the vats described will entirely supersede the launder system. In the first place we are not at all sure that such a plant will be built, and in the second place we have certainly not enough data at present to make even a guess as to the design of the precipitating system, but we are quite sure that the problem will be radically different as to possible labor costs, the precipitant, and the liquors to be treated from the present practice at Bisbee.

Regarding the precipitating vats: the adapting of the Dorr mechanism to such vats being considered an improvement will, I think, be at present a matter of opinion to be decided later in view of their performance. Regarding the chemistry of the process, this is complicated, and I do not feel personally that we have sufficient knowledge from experiment to warrant our considering that the equations given represent the facts. To some extent this is a matter of opinion, but I think it can be shown that some of them at least will not occur under the conditions of our process. We are on somewhat more solid ground in considering the equations which the article states are offered by Mr. Irving as representative of the reactions that take place in the ore-heap, since these are more or less the accepted ideas in regard to the reactions taking place in the Rio Tinto heaps. Whether or not they will be found to be those which will also take place under our new and radically different conditions I do not feel competent to say now and therefore can agree fully with Mr. De Kalb in his statement that the last word has not yet been written. Mr. De Kalb states that "it has not been definitely ascertained what proportion of the copper in the leach-tailing, which contains about 20% of the original copper, is in the form of metallics. It would be an interesting inquiry, since it is difficult to believe that any considerable amount of sulphide could escape the action of the solution after a year of treatment under conditions carefully maintained to secure the highest possible degree of oxidation." We have no leach-tailing containing 20% of the original copper, since as stated the leaching has so far only progressed to the extent of extracting 27% of the

copper to date in about eight months. Based on Rio Tinto practice we have assumed (and this is pure assumption) that the time required for treatment to a possible 80% extraction will be from three to four years. It is encouraging to note that, when we plot the curve against time of our actual extractions to date, it so far lies almost exactly on the line of our assumed time, but, of course, we have no safe way of extrapolating this curve, and I personally would be much surprised if more than 30 to 40% of the sulphides present will be acted on at the end of a year's work. The reactions are very slow at the best, and they cannot, in the nature of the problem, be maintained so as to give the highest possible degree of oxidation. It is quite evident, if we consider a single good-sized lump of ore, say, six inches or more in diameter, that either this will disintegrate or not. If it does not disintegrate then the leaching solutions must follow into the lump the practically microscopic channels through which the secondary sulphides were deposited. If disintegration takes place so that the process of penetration takes place more rapidly, then we are confronted by the above mentioned mechanical troubles.

A few more words regarding the description of the actual heap and its operation on page 756 of Mr. De Kalb's article will finish what I have at present to say on the subject. "No special preparation of the ground was attempted." This is a fact, but the preparation of the ground as a site for the piles forms one of the larger problems we have to investigate in our Tyrone work. "A vertical depth greater than 25 ft. is inadmissible owing to the danger of channeling." This is at present purely a matter of opinion and the depth will naturally differ with the character of the ore, the kind and strength of solutions, and the method of treatment. I am not now in a position to say that any particular height is either inadmissible or possible. Too shallow a pile is impracticable on account of the enormous space needed for any considerable production. Naturally the depth of pile is to be tested out thoroughly during our Tyrone work, but we cannot say now that we know anything about what depth of pile can be finally adopted. It should, I think, be emphasized, in criticizing this article, that the results so far are purely preliminary, and while they are encouraging they may or may not lead to ultimate commercial adoption of the method for our conditions.

G. D. VAN ARSDALE.

New York, January 17.

[Mr. Van Arsdale is welcome to the space taken by his criticism, which is interesting. We think it best that Mr. De Kalb should not reply, thereby avoiding an undesirable controversy. Of course, we regret if inadvertently Mr. Van Arsdale has been given insufficient credit, and Mr. De Kalb shares this regret. In regard to the chemistry of copper-leaching, we are well aware that many of the reactions are obscure, but that is no reason for not trying to clarify them. Mr. Van Arsdale's opinion concerning them would be interesting, as interesting as those of Mr. De Kalb. Meanwhile our readers will be more grateful to the metallurgist that discusses them than to those that prefer to remain silent in the expectation of saying the last word concerning the process. That they will never do, for we all die learning.—EDITOR.]

Patents and Royalties

The Editor:

Sir—You may perhaps remember that about a couple of years ago, I entered upon a little campaign to obtain some pecuniary recognition from users of Pachuca tanks in this country. I think, at the time, you wrote a paragraph in the PRESS, calling attention to my method of collecting royalty. Now, it will probably interest you to learn the result of this campaign.

When I was considering taking this action, I spoke to several friends, and most were of the opinion that I would not even receive an answer to a letter that did not have a legal threat behind it; but I have considerable faith in the good side of human nature and was not discouraged. As a boy, I was thrown upon my own resources in these Western States and I have always found that fairness begets fairness, and I am not afraid to trust my fellowman. When I had drafted a letter I showed it to a legal friend, and he shrugged his shoulders and remarked that it was very frank. Perhaps his legal training had produced in him this caution. The letter went forth, and, after waiting several months, I was almost forced to conclude that my cold-blooded business friends were correct; but I still cherished my hope in the fairness of true business-men. My patience was rewarded by receiving a letter from the manager of one of the large mines, briefly stating that he had been absent, and that my proposition seemed a fair one, and that he was pleased to pay on the tanks his company was using, at the rate set forth in my letter. I have not had the pleasure of meeting this gentleman, but have inquired about him from men who know him, and find he is one of those big men who has been found faithful in small things and is now entrusted with great things.

By this time practically all the real mines, or shall I say real managers, have paid the small recognition I asked, and from the letters I received it is easy to see that my appeal to fairness struck the chord that produced results. If I had relied on the legal stick there would have been 'nothing doing,' as I am afraid my temperament has not enough of the bulldog in it to bring a legal tussle to a successful issue.

It is a pity that fairness, which is inherent in all men, is not more used in our labor questions. Some years ago I had about twelve months experience noting the evidence given in the Arbitration Court in connection with a big labor dispute, and I came to the conclusion that, if it were only possible to get the men on each side together, fairness will accomplish more than all the legal argument that can be brought to bear on the question.

There were, of course, some mines that did not reply

to my letter, and as time went on, I was able to size up the management, by making inquiries from machinery agents and others I come in touch with. It is the old story, that a man who has not the courtesy or self-reliance to reply to a letter, is 'small.' Some users pleaded that the mine was not paying, and I am only too pleased to let the matter rest at that, and to hope that they will strike good ore.

F. C. Brown.

Silver City, Idaho, January 1.

[This letter was not intended for publication, but we wrote to Mr. Brown and obtained his permission to reproduce it in these columns.—Editor.]

Nickel-Copper Steel

The Editor:

Sir—I have noted with much interest the timely article on nickel-copper steel direct from the Sudbury ores, written by F. H. Mason and appearing on page 57 of your issue of January 12.

I would like to correct one statement made in this article, in which it is stated that Prof. Stansfield repeated Sjöstedt's experiments at the request of the Royal Ontario Nickel Commission. Mr. Stansfield, on the contrary, made his experiments at my request, and at my expense, and along the lines of the process which I had patented and which is now known as the 'Nicu steel' process, the rights having been sold by me to the Nicu Steel Corporation, Ltd. You will note in the report of the Ontario Nickel Commission that Stansfield experimented with a patented process. This is the process referred to, and I turned his report over bodily to the Nickel Commission, having secured it with the idea of obtaining corroborative evidence as to the success of the process from a high-class independent metallurgist. I believe that the Royal Ontario Nickel Commission afterward asked Mr. Stansfield to write a general article stating his opinion of the various methods of treating the Sudbury ores and his opinion concerning the qualities of nickel-copper steel. This also appears in the appendix to the Commission's report.

In reference to the criticism that is made concerning my estimate of the cost of producing nickel-copper steel, this seems entirely justified, since two tons of ore will not produce one ton of pig-metal; it actually takes about 2¼ tons, but in practice we have always mixed the Sudbury ore with a certain amount of steel or iron scrap, or iron ore, and the cost of this material I did take into account in estimating the actual cost of smelting. For example, in smelting the ore in an electric furnace, we had to use a considerable amount of steel filings in order to make a contact and this supplied the deficient iron to make up the ton of pig.

You may be interested to know that the Nicu steel process has actually been put into commercial operation at East Montreal in the month of October 1917, and about 90 tons of steel was made by this process, and some of it is entering into actual commercial use, while test-pieces are being examined by various war-boards and commissions in the United States and Canada. The manufacture had to be discontinued because it was impossible to rent the furnaces for a longer period than the one month, but we are now negotiating for the continued lease of a steel plant and hope to arrange to manufacture the steel continuously, even if only on a small scale.

In actual practice we reduced the roasted ore in an electric furnace and refined the pig first in an electric furnace, but afterward, and with much better success, in an open-hearth furnace. We believe that eventually we shall be able to carry on the process along the lines of regular steel manufacture, reducing the roasted ore in a blast-furnace and refining in an open hearth. This, of course, will enable us to manufacture the steel at a considerably lower cost than could be effected by the use of electric furnaces.

G. M. Colvocoresses.

Humboldt, Arizona, January 15.

Native Iron Reduced by Oil

The Editor:

Sir—The editorial in your issue of December 29, in which you facetiously remark that "As far as we know, no vein or other natural deposits of brass or even 'steal' have been discovered in Arizona or in any other of our rich and varied mineral regions," brought to my recollection an inquiry which I had from a correspondent, about three years ago. His letter says, "I am interested in a prospect down near the coast, on which we are boring for oil. We have had very great difficulty in breaking through a stratum that lies 1635 ft. below the surface. It took us two or three days before we could begin to make an impression, and then we only went through two or three inches per day, until we went through 18 in. of the material." I found the sample which he enclosed in his letter to be metallic iron, in grains of a slightly spongy character. In a subsequent letter he informed me that they had found oil underneath, although not in sufficient quantity to be of commercial value. I had already informed him that this would probably be the case, for it is apparent that a bed of hematite had overlain the oil and had become reduced to that metal through the action of heat. Although I have heard of large masses of metallic iron being found in Greenland, and in smaller quantity elsewhere, especially in dike-rocks, I had never previously heard of a deposit of the metal. As its appearance in that form appears to me to be unique, it would be interesting to hear if any of your readers have had a similar experience.

Thos. French.

Nelson, B. C., January 9.

Exports of bituminous coal from the United States has increased from 16,083,101 tons in 1913 to 19,628,848 tons in 1917. The greatest increase was to Italy, the figures being 332,264 and 1,099,508 tons respectively.



RAILROAD STATION AND PLAZA, AJO, ARIZONA

Ajo Copper Mine—II

By COURTENAY DE KALB

EXPLORATION. The Ajo deposit was developed by diamond-drilling, done by the E. J. Longyear Co., of Minneapolis, on contract. The diameter of core at the beginning was $1\frac{1}{8}$ in., and was the same at the bottom of the holes. The average depth of the holes was 300 ft., and in the centre of the deposit they extended to a depth of 1000 ft. The rods were pulled every 5 ft. and core-samples taken. The total sludge from each 5-ft. section was also collected in barrels and settled. The water was decanted, the whole of the sludge being dried and quartered down to a sample of about four pounds for assay. The entire area was surveyed into blocks 200 ft. square, and a drill-hole was sunk at each corner. Mr. Joralemon states that, "Owing to the thoroughly fractured uneven nature of the rock, the recovery of core was low, and neither core nor sludge-samples alone were satisfactory. To obtain an accurate assay-value for the ore developed, the length of core for every 5-ft. advance was measured, and on the basis of this length of core the sludge and core-assays were combined to give a final value, which represented all the material removed from the hole during the 5-ft. advance." After developing with drills for a period of six months the results were checked by test-pits 4 by 6 ft., sunk with the aid of windlasses. This work was done by Mexican and Indian labor. Every tenth bucket windlassed from the pits was taken as a sample. After the pits were completed they were again sampled in 5-ft. sections by channeling. Eighty-four diamond-drill holes were sunk; they ranged from 200 to 1000 ft. in length, aggregating 23,097 ft. of hole. These were checked by 77 test-pits, amounting in all to 3955 ft., of which 3600 ft. was in carbonate ore. In addition to this the sulphide ore was explored by 1513 ft. of drifts. The estimate based on the data obtained in this way was as follows: 11,954,400 tons of carbonate ore assaying 1.54% copper, and 28,303,600 tons of sulphide ore assaying 1.50%. Of this amount 32,481,200 tons was available by steam-shovel mining, leaving only 7,776,800 tons of sulphide ore, of an average copper content of 1.40%. The unoxidized orebody will be removed ultimately by caving. The central part of the deposit is available without the necessity of stripping overburden, since the copper extends in undiminished quantity to the very surface. Around the edges, however, are patches of overlying rock that represent a total of 3,308,000 tons that must be stripped. This overburden assays above 0.63% copper, and is not necessarily waste. As Dr. Ricketts once said to me while looking over the vast tailing-pile at Cananea, "The stuff is useless for anything today except to serve as a fairly good dam for our settling-pond, but some wise metallurgist in future will extract the copper from it; the waste of this generation is the wealth of the next."

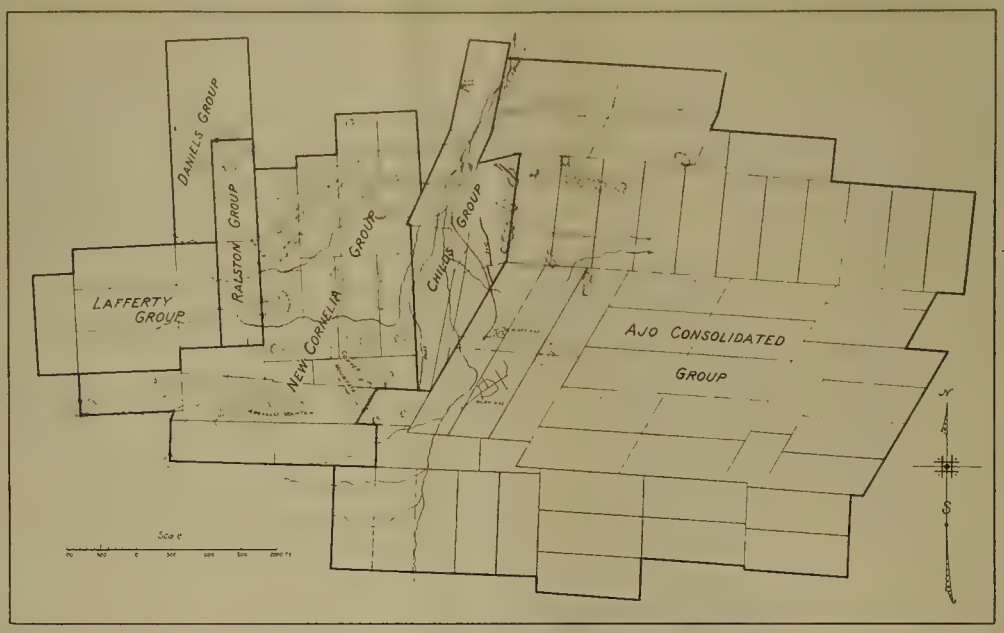
As soon as this exploration and development had been completed, the New Cornelia Copper Co. was organized with a capital stock of 1,200,000 shares of $5 par each, the capital being increased later to 1,600,000 shares, of which 1,201,600 were issued. An issue of $4,000,000 of 6% mortgage convertible bonds was authorized also, and the Calumet & Arizona Mining Co. subscribed to $3,100,000 of these at par. When the 'C. & A.' was listed on the New York Stock Exchange the circular issued to the public stated that the holdings were 90 patented claims aggregating 1629 acres, with 15 mill-site claims comprising 74.94 acres, and that the property drilled had shown 40,000,000 tons of ore having an average copper content of 1.51%; it also declared that the average monthly production would be 3,000,000 lb. of copper. This has now been completely realized, although the plant has barely passed the point of 'tuning up.' Oper-

ations started as recently as May 1917, and the necessary changes are not yet complete. In August the output was 2,200,000 lb. of cathode copper; and in October it had been brought up to 3,260,000 pounds.

On July 28, 1917, the board of directors issued a call to the stockholders for proxies, authorizing an important move for expansion. It was announced that the production in June had been 1,093,000 lb. of copper from the leaching-plant, and 225,876 lb. from ores shipped to the smelter at Douglas. The opinion was expressed that "there will not be any material difficulty in maintaining a recovery of at least 80% of the copper content of the ore." Then follows the statement that the opportunity had presented itself for adding to the ore-reserves of the company by the purchase of 7 patented and 52 unpatented mining claims, amounting to 1150 acres, covering an extension of the orebodies already owned. The circular set forth: "Part of this new ground has been explored by the former owners by 5500 ft. of drifts and raises, and by drilling, and the estimate of tonnage of ore in the explored part is 21,000,000 tons, averaging 1.55% copper. The character of these ores is identical with our old ores, the major portion being sulphides. We have not been able to check fully all the work, but have checked important parts by new drill-holes, and have examined the records and made numerous assays of samples furnished from the drillings, all of which were done by the same reliable contractor who drilled our old territory, so that we feel entirely satisfied of the value of the property to the New Cornelia Copper Co." The terms of the purchase were to deliver to the owners of the Ajo Consolidated Copper Co. 200,000 shares of New Cornelia stock, and notes of the company for $500,000 due in 6 and 12 months, respectively, with interest at 4%. The apparently simple ease with which a development company was able to convince a great corporation, mainly with its own development records and samples, and to obtain so large a sum in notes and gilt-edged securities, for a mine that represented a total capital expenditure of probably $700,000, finds explanation in a number of circumstances. The circular gives one of them: the same drilling-contractors had done the work, and their reliability had been demonstrated previously to the New Cornelia Copper Co. The employment of the same contractors that had served the one logical buyer of the mine displayed good business judgment. In the next place, the New Cornelia Copper Co. had finished its campaign of development, and had worked out the essential geological relationships before serious exploration on the extension was undertaken; in other words, the New Cornelia company had shown the reasonableness of expecting ore in a direction that if known in 1911 would have enabled them to avail themselves of a proffered option on this area at a price of only $300,000. Finally, the owners of the Ajo Consolidated Copper Co., namely, James Phillips Jr. and associates, placed the control of their development campaign in the hands of a capable manager, James P. Gaskill, in whom the heads of the New Cornelia Copper Co. had confidence as an engineer and as a man of integrity. To meet the requirements of this purchase the New Cornelia company increased its capital stock to 1,800,000 shares. It may seem that the directors paid heavily for what some might deem lack of foresight, but the argument will not hold. To be sure, money would have been saved by accepting the earlier opportunity, but a considerable amount of spot-cash was demanded by the original owners at that time, and this would have increased the initial outlay at a moment when the entire project rested on hope, restrained by the discouragement of previous investigators. The argument, in fact, might be turned the other way: the old Ajo Copper Co. which later sold its interests, together with such rights as had been held by the Rendall Ore Reduction Co., to James Phillips and his associates, who then organized the Ajo Consolidated Copper Co., might have obtained a larger sum in the end by offering the property to the New Cornelia on such liberal terms as would have postponed all payments until the first nut had been cracked. Until the faith of Capt. Greenway, Dr. Ricketts, and their comrades, had been vindicated by the drill on Copper mountain, it was wise to defer expenditures looking toward expansion; equally was it a matter of sound business policy to take over the property after their own development and that of their rational neighbors had shown that a reserve of 520,800,000 net pounds of copper, together with an area offering possibilities of many times the amount by further development, could be purchased for 0.29c. per pound of net recoverable copper on a basis that, as the circular stated, "need not defer the time when payment of dividends can be commenced."

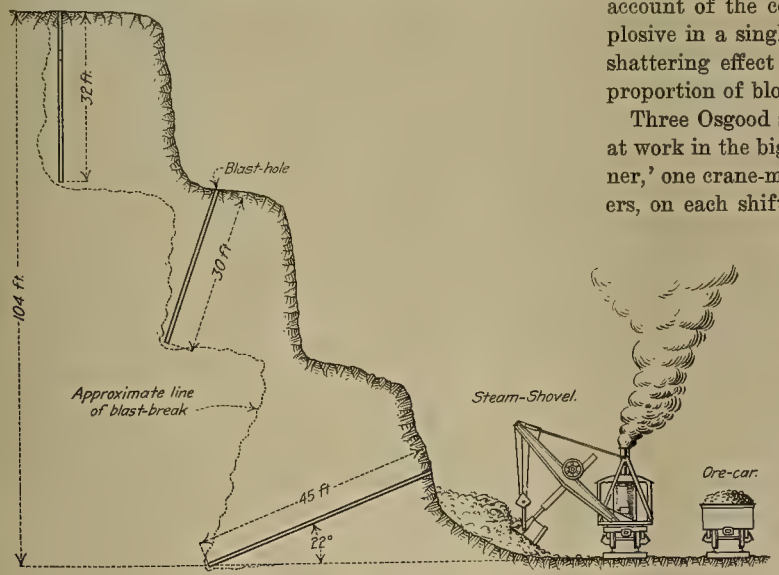
THE MINING OPERATIONS are relatively simple. A standard-gauge service-track 4000 ft. long extends from the level of the upper floor of the crusher-house to Copper mountain. It enters the orebody through a cut, and divides into two tracks, serving steam-shovels on each side of a great open-cut across the mass of carbonate ore. The width of the open-cut is over 200 ft., and the maximum height of face against which the steam-shovels are advancing is 125 ft. The cut is about 2000 ft. long, and as it widens it will take an irregular slice over 66 acres; 750,000 tons have already been excavated and sent to the metallurgical plant. The mining is under the superintendence of Fred R. Eckman, a man trained to efficiency in the hard but expansive school of the Lake Superior iron mines, in which the American practice of mining 'in the large' chiefly has been developed. The accompanying sketch illustrates the manner of attack. Near the bottom is drilled a series of holes to serve as 'lifters,' each 45 ft. deep, and inclined at an angle of 22° from the horizontal. Next comes a series drilled on a bench about 75 ft. above the bottom, bearing into the wall. These holes are 30 ft. deep and break to a lower bench above the lifters. A third series is drilled vertically to a depth of 32 ft., and 18 ft. back from the edge of the ore-face. The holes in each series average about 18 ft. apart horizontally. Ingersoll-Rand air-drills are used, taking air at about 70 lb. pressure, and 3¼-in. drill-steel is employed for start-

ing the hole, drawing down to 1¼ in. at the end. The hole is then sprung with 40% dynamite, this being repeated twice, and consuming 1½ boxes of powder. The chamber is then loaded with four cases of 25% dynamite. This rock has resulted in an excess of large masses over the amount originally estimated, and the labor-shortage makes it difficult to obtain a sufficient force of drillers. Therefore, the full quota of 5000 tons of ore daily is at



MAP OF CLAIM GROUPS AT THE AJO MINES

is now being replaced to a considerable extent with black powder. For each pound of total powder used four tons of ore are broken. The larger masses are block-holed, employing jack-hammers. The block-holing would not



METHOD OF BLASTING HIGH BANKS

seem to be a serious matter, since the No. 24 gyratories in the crusher-house will take pieces of ore 8 ft. long by 4 ft. in the other two dimensions, and the steam-shovels will load blocks of that size; but the character of the present difficult to deliver to the crushing-plant. It is proposed to drill holes on the high banks in future with Cyclone churn-drills, set about 15 ft. back from the edge in which charges of Trojan powder will be fired. On account of the concentration of a large quantity of explosive in a single charge, it is expected that a superior shattering effect will be obtained, thereby reducing the proportion of block-holing to the total tonnage broken.

Three Osgood steam-shovels, with 4-cu. yd. shovels are at work in the big open-cut. A crew consists of one 'runner,' one crane-man, one fireman, and four Mexican helpers, on each shift. Four trains of 8-ton side-dump cars are constantly in service hauling the ore to the crusher-house.

At the south-west end of Copper mountain underground work is in progress along the contact between the monzonite and the rhoylite, under the charge of George Harmson. A shaft has been sunk 60 ft. deep, and a drift extended under the mineralized rhyolite, which at this point averages about 4% in copper that is present as minutely disseminated silicate and carbonate. The ore is broken around an open pit and drawn to the loading-chute through a mill-hole in the bottom of the funnel-shaped opening. It is estimated that 81% of the Copper mountain orebody is available for mining by steam-shovel, but this will involve working downward below the level of the ore-railroad by spiral benches.

The ground rises from the site of the metallurgical works, so that drainage of the pit will be easy to a depth at which open-cast work will cease. The mine is ideally situated for economical operation, and presents no difficult engineering problems so far as the original New Cornelia area is concerned. The extension of the deposit under the rhyolite, however, will call for the adaptation of caving methods to fit the special conditions there presented.

The building of a branch railroad was a necessity for the operation of a property that was to start with the treatment of 5000 tons of ore per diem. Surveys were made at first directly west from Tucson, a distance of 135 miles, passing through a region containing undeveloped agricultural resources, and many copper prospects in the Coyote, Comobabi, and Quijotoa ranges, where important developments have taken place. This would have afforded a route connecting at Tucson with the El Paso & Southwestern railway and leading to the smelters at Douglas. The alternative was to build over open plains between the scattered basin-ranges 43 miles northward to Gila Bend, a station on the Southern Pacific railway. This involved the least initial expenditure, which was important in view of the outlay of $4,000,000 needed for erecting a metallurgical plant. The railroad cost $700,000, and is operated under an independent organization styled the Tucson, New Cornelia & Gila Bend Railway Co., of which one-half the capital is held by the Calumet & Arizona Mining Co. In the title lies a suggestion of the ultimate construction of the line through to Tucson, which would appear logical.

An Impression. The approach to Ajo is over a typical Arizonan desert-plains depressed between surrounding ranges in the form of vast basins, overgrown with creosote in the lower portions, and adding bayoneted yuccas and opuntia cacti toward the heads of the clino-plains. The color of the landscape in the broad perspective is green, suggestive of an abundance of verdure, which, however, is not confirmed by the barren ground near at hand over which the creosote bushes are seen to grow far apart in a kind of distant association with each other. The mountains are mostly gray, except where remnants of the basaltic lava-flows form black frowning mantles over the older rocks. At one place a great fault has involved the underlying formation as well as its lofty burden of lava, and along the fractured zone is a broad band of iron-stained outcrop that makes a brilliant display. These lavas once covered the Ajo ore deposit, and a few iron-stained fragments still endure on its higher points. Erosion swept the cap of lava away until the ore was left exposed to the sun. The purplish peaks of altered rhyolite are visible from the train, rising behind the brown hillocks of ore, while toward the north swings the grayish lavender range constituting the extension of the grano-dioritic mass of which the orebody is in a favored differentiate. The town and the works spread around the entrance to the amphitheatre, in the centre of which is Copper mountain. The place looks like a city, and so indeed it is, built at the command of the copper barons with the magic of money, industrial purpose, and proved resources. The train halts in front of a station of unexpected beauty. No suggestion of what the West calls a mining 'camp' was here; it was like coming to a fashionable resort for tourists. The sky was of Algerian brilliancy, and the air was soft and exhilarating. The beautiful double colonnade and Moorish towers of the station aided the delusion of being in northern Africa. The richly-colored arches extended for the distance of a city-block on either side of what one hesitates to call a 'ticket-office' when surrounded by so much æsthetic charm. Through the arches was a vista of a deep-green plaza, the carefully tended lawn rising gently toward a low tower surrounded and almost concealed by flaming oleanders; and along the other side of this remarkable plaza, which would make the cities of San Antonio or San Diego envious, is a continuation of Moorish structures and broad colonnades. It presently appears that here is concentrated the activity of the town. It is a civic centre in an unusually real and delightful sense; at the Plaza is found the post-office, and the offices of the local civil authorities, the stores, cafés, and chocolate-shops, the 'movies,' and all that makes up the round of business and pleasure of the community. Whatever one may need, just as in a Spanish city, he will find at the Plaza! There is where people meet, where they find refreshment, and listen to the band in the limpid Arizona nights while the children romp upon the electric-lighted green, for in some way, which means with the aid of a generous purse, the New Cornelia Copper Co. has found it possible to dispense with the customary disheartening injunction to "keep off the grass." In a spirit of delightful democracy the children of the staff and of the laborers mingle in their play for a while under influences that make for a better understanding between them all. It was a costly bit of luxury for a mining company to offer all this before it had begun to make a profit from its enterprise, and the vision to undertake such extraordinary welfare-work is credited to a member of the directorate, a man of fine feeling and generous sympathies, now mourned as one lost from the council-table, the late Chester A. Congdon. It was a practical thing to do, for it meant relief from the ugliness and despair of the customary 'mining camp' with its glare of barren clay and sand, its piles of rusting tin-cans, and its spiritual vacuity; it meant refreshment, re-invigoration of body and mind, and the conservation of self-respect through respectable and cheering surroundings. Thus it has proved as good an investment as some of the new mills, and lead-lined pumps, and other accessories introduced to help in the mining of ore for profit.

Ottawa, Canada, now claims the largest gold refinery in the world. The Ottawa mint was recently enlarged, and is now capable of treating 250,000 oz. per week by a chlorine process. Since the beginning of the War Canada has handled one billion dollars' worth of bullion for the British government and the Bank of England.

Controlling Fires at the Copper Queen Mine

By GERALD SHERMAN

*Mine-fires are always dangerous and are frequently accompanied by loss of life during the period of confusion that is apt to follow their discovery. In metal mines, fires may result from the accidental ignition of some combustible material, or they may be of spontaneous origin resulting from the rapid decomposition of sulphide. They occur frequently enough to demonstrate the need of some special equipment and a general plan for controlling them, in addition to measures for their prevention. Nearly all the large copper mines have had fires, and the methods of fighting them have been well described in recent papers, notably by C. L. Berrien,[1] R. E. Tally,[2] and others in discussion.

The Copper Queen mine has many shafts, which are connected by underground workings. The deeper parts are ventilated by fans, but in the shallower portions natural ventilation through numerous connecting raises or shafts is sufficient. There have been several fires in the past few years, of which all are extinguished but one, and that is under control. These notes cover particularly the preparations that are being made to check a new fire, partly or temporarily, and to facilitate the escape of workmen in the interval before a definite plan of fighting it can be established.

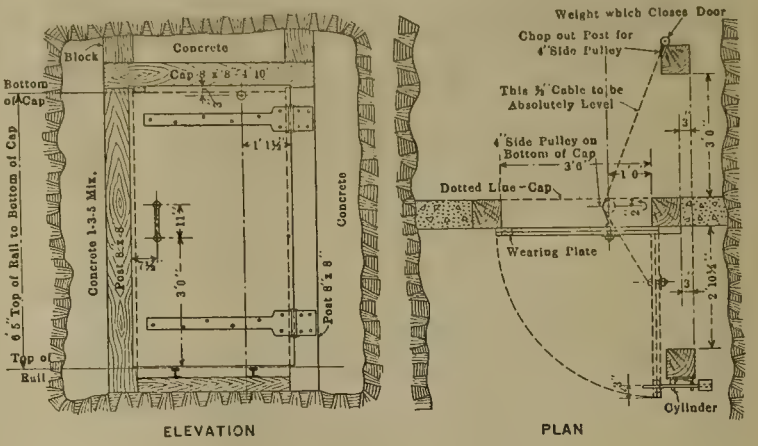


FIG. 1. METHOD OF MOUNTING FIRE-DOORS

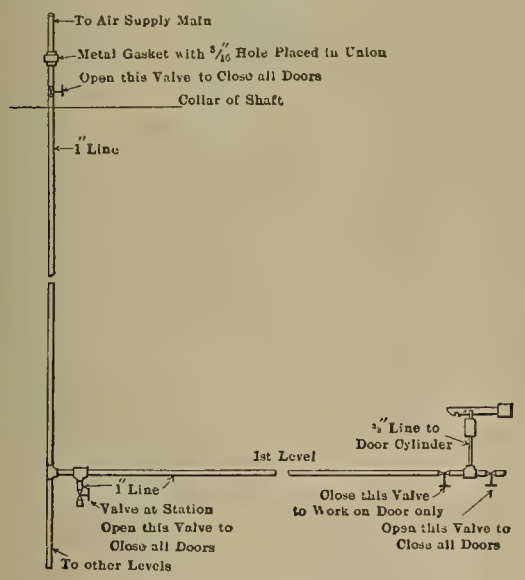


FIG. 2. PIPE-CONNECTIONS FOR OPERATING DOORS

A fire may occur in a shaft or station, or in some working farther away. In case of fire in an upcast shaft, the gas would escape to the surface and the immediate result would probably not be dangerous to workmen, as they could escape by other shafts. In a downcast shaft, however, the gas would be distributed rapidly throughout a large portion of the mine, and men might easily be trapped and asphyxiated. A fire in mine-workings, drift, raise, or stope, would be dangerous in a degree, but the draft there is likely to be less strong than in a shaft and probably a small area would be invaded by the fire-gases.

At the Copper Queen mine, in all drifts connecting with individual shafts, systems of doors are now being constructed that may be closed at any moment, cutting off the circulation of air as completely as possible, so as to check or stop the draft. Thus, in case of fire in any shaft, the doors in all drifts communicating with the shaft can be shut immediately and simultaneously, and water can then be turned on through a sprinkling system to put out the fire, if possible. In case of fire in interior workings, the doors of one or more shafts connecting with the section affected will be closed at once, thus isolating the fire-district and protecting exits from the mine as well as checking the progress of the fire. In a way, these doors will serve a purpose similar to the

*A paper to be read before the American Institute of Mining Engineers at the New York meeting, February 1918.

[1]Fire-Fighting Methods at the Mountain View mine, Butte, Mont. Trans. (1915), 52, 534.

[2]Mine-Fire Methods Employed by the United Verde Copper Co. Trans. (1916), 55, 186.

collision-bulkheads in a ship. Several shafts are already equipped in this manner and all will be, as soon as possible.

A sketch of the doors is given in Fig. 1, and a diagram

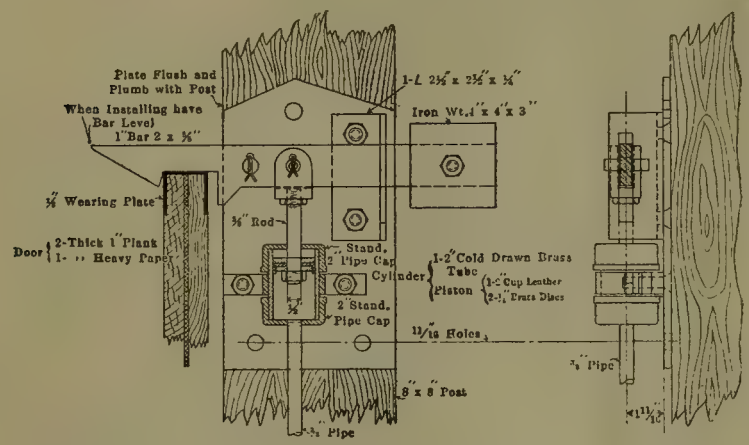


FIG. 3. DETAIL OF LATCH MECHANISM

of the piping system through which they are operated is shown in Fig. 2. Fig. 3 gives details of the operating mechanism. The doors are set in concrete, and are normally held open by a latch; when the latch is thrown, the door is closed by a weight. The latch is held closed by an air-cylinder acting against a counterweight. The air-cylinders connect by piping with all doors protecting the shaft and with the compressed-air main on the surface. By opening a valve at any station, or at the surface, the air system is drained of air, the pressure on the cylinder falls, the weight throws the latch, and allows the doors to close. Any door, of course, may be opened by hand afterward. A small hole in a metal gasket furnishes enough air to supply leakage in the pipe system but not enough to prevent the fall in pressure when any valve is opened. By this arrangement, if anything goes wrong with the piping or air-pressure, the doors close automatically; if the latches were thrown by cylinder-pressure, instead of the reverse, they would fail in case of accident to the air-line or its injury by the heat of a fire not quickly discovered. It is probable that the doors cannot be made air-tight, but if necessary they can be easily and quickly caulked by helmet-men after they are closed.

The arrangement would be of benefit whether the shaft be down or upcast. In case of an upcast shaft, the result would be the checking of the fire because, without the doors, the draft would be increased by the fire. In case of a downcast shaft, it would largely prevent gas from passing into the mine.

After the doors are known to be closed, it will be safe to turn water into the shaft; but until they are closed, or until all men are known to be out of the dangerous part of the mine, it might be extremely dangerous to turn on water, as this would cause a downdraft, carrying gas and fire into the workings.

Pouring water into the top of a shaft does not seem to be effective in extinguishing a fire, as but a small proportion of it reaches the desired point. Pipe-lines therefore are laid down the shafts, to carry water to sprays set under the timbers at 25-ft. intervals and pointing down (Fig. 4). Uniform flow is obtained through all sprays by adjusting a service cock in the line connecting each spray with the shaft main. Water can be turned on only from the surface. By this means, a shaft can be saturated with water quickly and effectively, the only difficulty being that it may be necessary to delay turning on water until the fire has attained considerable headway, that may have damaged the shaft and pipe-line sufficiently to interfere with the distribution of water. Fusible plugs could be used in the sprays, but it is feared that spraying at the wrong time might endanger men in the mine. If the stations are timbered, it might be advisable to have sprays with fusible plugs distributed in them.

As at present outlined, the general procedure in case of a fire would be:

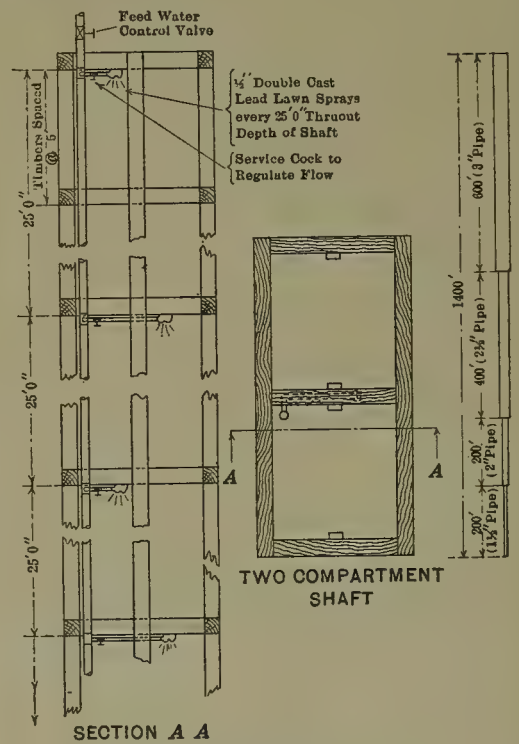


FIG. 4. CONNECTIONS FOR SPRAYING SHAFT

1. Giving a general fire-alarm, the district in which the fire occurs being indicated by flashing a number on all electric lights on the property.

2. Closing of doors communicating with the dangerous area, and shutting down the fans.

3. Getting workmen to the surface.

4. Turning on shaft sprays.

5. Development of a general plan for fighting the fire or controlling it within certain limits. Those ventilating fans that can be operated safely may be started.

In case of fire within the mine, shaft-spraying would be unnecessary unless the fire were so close that it would be desirable to saturate the timbers to prevent their igniting easily.

It is probable that, in the future, additional doors, which may be closed from the surface as well as from other points, will be placed at various places in the mine; this will divide the mine into sections with the expectation of isolating a fire, checking it somewhat, giving time for men to escape, and permitting a method of fighting to be established, as in shaft-fires.

It has been found that serious delays often occur in getting water to a fire, even though compressed-air piping can be connected with water mains and used for the water system. Experiments are now being conducted in the use of a chemical fire-engine that may be of assistance in certain cases. However, carbon di-oxide from the engine is as dangerous as fire-gas, and it would not be safe for men without helmets to use the engine unless the carbon di-oxide could be carried away by a positive draft.

A portable fan operated by a storage battery is kept in service; this can supply local ventilation to assist in getting at the fire.

Future of Electrolytic Zinc

*The average zinc recovery by the electrolytic method is less than 70% from ores or concentrates containing 40% Zn, but as 90% extraction has been reached the average recovery will increase when the causes for disparity have been found. By proper roasting, 90% extraction from ores of 15 to 25% Zn is not difficult to obtain. A Wedge furnace with seven hearths and 22 ft. diam. will roast 1¼ tons of ore per hour. After roasting zinc concentrate containing 45% Zn, 95 to 97% extraction is possible. No more experience is required for the electrolytic process than for the retort process. The electrolytic is as much dependent on cheap power as is the retort process on cheap fuel. Labor and power-costs favor the retort process while roasting in a Wedge furnace is less costly than that in the special furnaces used for roasting the ore for retorting. An ore having the same lead and silver content, but with 25% Zn, will have an increase in cost of production of 0.05c. per lb. of zinc, but the zinc recovered pays for the ore and leaves a small profit, and the residue has been reduced one-half for the lead smelter. An aspect in favor of the electrolytic process is the presence of manganese as an essential preventive of sulphating or destruction of the anodes in the electrolytic vats. It purifies the electrolyte by decomposition on the anode as hydrated MnO_2. In manganese-bearing zinc ores the manganese may be recovered for use in dry batteries. Solution of the zinc in the roasted ore is accomplished with very little loss of sulphuric acid through precipitation of basic iron sulphate, but since iron and lead deplete the solution of more sulphate than the $ZnSO_4$ furnishes, SO_2 from the roaster is brought into contact with MnO_2, and $MnSO_4$ is formed from which MnO_2 is deposited electrolytically, while the H_2SO_4 is thereby added to the circuit.

*Abstract (Chem. Abst.); T. French, Trans. Am. Elect. Chem. Soc.

France Using Cast-Iron Shells

France is making more than a million cast-iron shells per day, according to the competent testimony of Edgar A. Costa. In arguing for cast-iron as opposed to steel shells, Mr. Costa points to the superior effectiveness of the iron shells in attacking earth-works. He claims that the efficiency of a shell fired against troops is dependent almost entirely upon the character of its fragmentation. In this respect cast-iron shells have been demonstrated to be more satisfactory than forged steel projectiles. The former, also, can be made easily in enormous quantities, given proper foundry practice. France is making the large number of shells mentioned in dry-sand molds. A steel forging for a 4.7-in. shell costs over $7; a cast-iron shell of similar size can be made for a little more than $2. The case of the iron-shell seems complete with these advantages, if they can be made under foundry conditions that will insure that they will be uniform and satisfactory in quality. To achieve these results Mr. Costa advocates the permanent mold, in which he has had wide experience. The theory of the cast-iron shell is that, when used against earth-works, the greater part of the explosion is not expended in bursting the walls of the shell, and the effect is as if the amount of explosive were detonated in the earth-work. When used in the open, the great fragmentation of cast-iron will allow the shell to burst into a far greater number of pieces than a steel shell, and to cover the zone of dispersion closely. There is nothing new, however, in the use of cast-iron projectiles. Before the age of steel they were the sole means of battering down defences and of attacking at long range. Some reasons for their being abandoned are that the metal has never had a good reputation for uniformity and freedom from sponginess and gas-holes. Its tensile strength is low, and it lacks toughness. Casting in permanent, or metal molds, is claimed to rectify these and other defects.

THE HABER process has been investigated in the United States at the Arlington plant under control of the Department of Agriculture, and is economically producing synthetic ammonia. The plant is open to public inspection, and it is expected that large private industrial works will follow from this government initiative. The process is extensively applied in Germany.

Lead Industry in 1917

The lead content of ore mined in the United States in 1917 was about 640,000 tons, this being an excess of 17,000 tons over the output in the previous year. Joplin gained 8000 tons, California over 5000 tons, Idaho 4000 tons, and Washington and Montana 2000 tons each. Tennessee suddenly rose from an insignificant output to nearly 3000 tons. Arizona and Utah lost about 4000 tons each and Colorado about 2000 tons as compared with 1916. The disseminated lead district of south-east Missouri remains the largest producer of lead, the output for 1917 being practically the same as in 1916. The Bunker Hill smelter at Kellogg, Idaho, was completed and put in operation during the year. The Empire Smelting & Refining Co. re-built the old smelter at Deming, New Mexico, and treated ores from April until October, when the plant was destroyed by fire. The Ontario Smelting & Refining Co. is building a soft-lead smelter in the north-eastern part of Oklahoma, a few miles south-west of Baxter Springs, Kansas. It will be equipped with four Newman automatic hearths, a lead blast-furnace, and a bag-house. The following estimates have been compiled by C. E. Siebenthal from reports made to the U. S. Geological Survey from all the lead refineries and soft-lead smelters that were in operation during the year.

Domestic and Foreign Lead, Ores, and Bullion. The production of refined lead, desilverized and soft, from domestic and foreign ores in 1917 is estimated at 599,000 tons, worth, at the average New York price, about $110,000,000. The corresponding figures for 1916 were 571,134 tons and $78,816,000. The figures for 1917 do not include an estimated output of 20,000 tons of antimonial lead, worth about $4,600,000. The production of desilvered lead of domestic origin, exclusive of desilverized soft lead, is estimated at 297,000 tons, against 316,469 tons in 1916; and that of desilverized lead of foreign origin at 59,000 tons, compared with 18,906 tons in 1916. The production of soft lead from Mississippi Valley ores is estimated at 243,000 tons, compared with 235,759 tons in 1916. The final figures for the production of soft lead will show an increase of a few thousand tons over those here given. In consequence of the great demand and high price about 5000 tons of secondary lead, and over 4000 tons of secondary antimonial lead, were recovered at the regular smelters. Refiners of argentiferous lead treated some ores from the Mississippi valley, which is not reported separately.

Imports and Exports. The imports of lead are estimated at 20,000 short tons of lead in ore, valued at $2,200,000; 37,000 tons of lead in base bullion, valued at $5,100,000; and 4400 tons of refined and old lead, valued at $650,000, a total of 61,400 tons, valued at approximately $8,000,000. The lead imported into the United States during the first 10 months of 1917, comprising lead in ore, bullion, and pigs, and old lead, originated as shown in the following table:

Imports, January to October 1917. Short Tons

	From Mexico	From Canada	Other countries	Total
January	2,665	1,762	33	4,460
February	964	292	918	2,174
March	4,534	1,528	94	6,156
April	4,162	515	647	5,324
May	5,680	365	198	6,243
June	4,502	107	1,344	5,953
July	3,653	164	4,381	8,198
August	7,509	1	271	7,781
September	6,285	80	118	6,483
October	2,510	33	386	2,929

The exports of lead of foreign origin, smelted or refined in the United States, showed considerable increase. They are estimated at 17,000 tons, worth $3,300,000, against 9880 tons in 1916. These figures do not include the lead in foreign lead manufactures exported with benefit of drawback, which amounted to 3227 tons in the first half of 1917. For the last four years notable quantities of domestic lead have been exported to Europe, and the total for 1917 is estimated at 48,000 short tons, valued at $8,300,000, compared with 100,565 tons, valued at $13,508,203, in 1916.

Pig-Lead Exports, January to October 1917. Short Tons

	From domestic ores	From foreign ores
January	8,095	641
February	3,030	133
March	3,744	959
April	3,454	2,382
May	4,197	1,209
June	6,621	742
July	3,135	90
August	1,905	89
September	4,346	104
October	2,665	10,520

Lead Available for Consumption. The quantity of lead available during 1917 may be estimated by adding to the stock of foreign lead in bonded warehouses at the beginning of the year (12,369 short tons) the imports (about 61,400 tons), and the domestic production (540,000 tons), making an apparent supply of 614,000 tons. From this should be subtracted the exports of domestic lead (48,000 tons), the exports of foreign lead (about 17,000 tons), the foreign lead contained in articles exported with benefit of drawback (about 5000 tons) and the stock of foreign lead in bonded warehouses at the end of the year, which is assumed to be the same at the end of October, namely, 16,777 tons, leaving 527,000 tons available for consumption, compared with 477,384 tons in 1916.

Market Prices for Lead. At the beginning of 1917 the price of lead in New York was a little over 7.5c. per pound, but it soon began to rise, reaching 10.5c. late in February and early in March. There was a decline to 9.25c. early in April, but this was followed by a rise that reached 12.25c. in the middle of June. A sharp decline then set in, and although there was a slight recovery late in July and early in August, the price went down to 5.5c. in November. From this point the price gradually rose, and at the end of the year was about 7c. per pound.

Scientific Nominalism and Flotation Physics

By DUDLEY H. NORRIS

The science that treats of external Nature, aside from human consciousness, which science is generally called metaphysics, is divided, like all Gaul, into three parts: 'realism,' which holds that there is such an external existence; 'conceptualism,' which holds that all we can know is our intellectual impressions; and 'nominalism,' which holds that we cannot know a thing until we name it and that then we know only the name and nothing else—*vox et præterea nihil*. As concrete examples, Thomas Carlyle was a realist, John Stuart Mill was a conceptualist, and Immanuel Kant a nominalist. Carlyle wrote 'Sartor Resartus' as a burlesque on the Kantian philosophy, and in the burlesque the University of Königsberg appeared as Weissnichtwo, Kant as Professor Teufelsdröckh, and his philosophy as the Philosophy of Clothes, the basic principle of which philosophy was that it is only externals, clothes, that count, and that the human being inside them is nothing. To exemplify this principle Professor Teufelsdröckh discoursed of a great state ceremony with the Sovereign and other royalty, surrounded by a splendid court magnificently attired with jewels and decorations, when, suddenly, every stitch of clothing, every article of adornment vanished and of the gorgeous assembly nothing remained but the naked individuals composing it and these scurrying to concealment like rats to their holes.

Science has for centuries been dominated by nominalism. Sánchez, a Spanish philosopher of the 16th century, said that "science must be free from the word-lumber of the schools and put its questions directly to things themselves." This is just as true today as it was then; but we do not have to go over to Spain nor back to the 16th century to find it out. Within the past couple of years there have appeared in the MINING AND SCIENTIFIC PRESS perhaps half a dozen articles written to prove that flotation is caused by electricity, and in the course of the respective demonstrations the writers have made use of such words and phrases as surface-tension, electro-statics, polarity, electric charges positive and negative, electro-phoresis, electrical endosmose, diaelectric films, contact-angles, contact-layers, electric charges of the bubbles, frictional electrifying of the bubbles and the pulp, hysteresis, ions, electrons, electric conductors, electrified bubbles, a conducting fluid, interfacial tension, osmotic pressure, liquid skins, all of which scientific scholastic epithets seem to be summed up in the despairing end of one article: "It is no wonder that great difficulty has been experienced in the practical application of flotation to ores, when such delicate electrical forces have to be considered." Still, in all these words and phrases there is nothing that touches the reality of either flotation or electricity.

The great trouble is that these names and their corresponding mental images are projected into the objective universe and considered as realities forming part of it; thus cohesion, adhesion, adsorption, capillary attraction, and the terms used in magnetism and electricity and the rest, are generally so considered, whereas they exist only in the mind. The same is true of the widely current fallacy that "Time is no part of Eternity." As neither Time nor Eternity can be conceived as objective existences they cannot be compared as such. The point I desire to make is illustrated by the homely adventures of the four blind men with the elephant. One caught hold of his trunk, the second of his fore leg, the third bumped against his side, and the last caught hold of his tail. On comparing notes the first said that the elephant was very like a snake, the second like a tree, the third like a wall, and the last like a rope; and they were all justified in their conceptions of the elephant and yet he was not any of these things nor all combined.

One of the worst offenders in this direction is Professor Milliken, of Chicago, who has recently published a book, 'The Electron,' reviewed in the Eastern papers. Here is an extract from the book: "It looks as if the dream of Thales of Miletus had actually come true, and that we have not only found a primordial element out of which all substances are made, but that that primordial element is hydrogen itself." The basis of the 'electron' fallacy is the projection of the hypothetical mathematical point into Nature. It is a fiction of mathematics that a point has neither length, breadth, nor thickness, but only position; that a line has length, but neither breadth nor thickness, and may be imagined as made up of an infinite number of points placed side by side; that a plane surface is in the same way made up of lines and a volume of planes. As long as we realize that all this is a mere fiction, like the legal fiction of John Doe, no harm or confusion can come of it; but if we try to project the mathematical point into nature or to identify John Doe in the flesh, we are on a sleeveless errand. Then, in electricity we have another mystery, and as long as the whole matter is nothing but speculation it might as well be magnificent. When we tickle amber it laughs electricity, so we will call the projected point an ambre, or, better yet, use the Greek word for amber and call it an 'electron.'

The theory of a primordial element was not a dream of Thales, at all. It was a self-evident pre-supposition of the Ionic school of philosophy that a single cosmic mat-

ter lies at the base of the entire process of Nature and the only question was to determine what this elementary matter was. While solid matter appeared dead, moved only from without, the liquid and volatile made the impression of independent mobility. There was a school that held to 'hylozoism,' or the doctrine that this cosmic matter contained the essential principle of life, and included within itself, as an essential attribute, all the forces necessary to produce all natural phenomena; that it was essentially omnipotent. All this nucleus of the Ionian philosophy is tucked away in the first verse of the Gospel of St. John, but so badly translated that it can only be compared with Josh Billings' translation of *'tempus fugit'* as fly-time.

Thales ascribed souls to magnets and declared the whole world full of souls. He declared, 600 years B. C., that this cosmic matter was water. Anaximenes believed air to have a quality, namely, infinity, that water lacked. Heraclitus, 500 B. C., declared the world to be an ever-living fire. Empedocles, fifty years later, compromised. He admitted as elements these four subjects of popular thought and that they were each without beginning, imperishable, homogeneous, unchangeable, eternal, and indestructible; but he sought a cause for motion outside the elements and called that cause 'love' and 'hate.' If he had said 'attraction' and 'repulsion' Empedocles would have been fully abreast of 20th century science. As it was, he taught that animals had arisen here and there, without any rule, and that in course of time only those fitted for life in their surrounding circumstances maintained themselves and that man had no other origin than growth out of the animal world. Also, a mixture of elements where 'love' ruled and 'hate' was excluded, he called 'sphairos,' which is Greek for 'sphere.' Thus Empedocles, only 150 years later than Thales, had invented 'survival of the fittest' and the 'descent of man,' anticipating Darwin some 2300 years; and he could have told our modern physicists that when water fell through space it needed no film nor any surface-tension to form a sphere. It did it 'on its own.' Anaxagoras, contemporary with Empedocles, hit upon a force-element that he called 'aether,' the lightest and most mobile of all elements.

These Ionians, inhabiting the Ionian islands, west of the Grecian mainland, were from their surroundings seafarers. They understood astronomy, navigation, and the tides; it was necessary for them to interpret natural phenomena, and from this necessity arose their development of the inductive logic and their wonderful understanding of the bases of natural philosophy. The greatest of the Ionian philosophers was Democritus, whose system, 460 to 360 B.C., was for the mechanical explanation of Nature. This means that unknown phenomena must be explained and interpreted in terms of our previous knowledge and not in terms of final causes, much less in terms of a theory invented on the spot and including in the purported solution of a problem the very terms of the problem itself.

In a recent lecture at the University of California Aristotle was said to be a colossal failure as a scientist because he had said that a large heavy body would fall more rapidly than a small one, which Galileo proved to be erroneous. Aristotle was an Athenian, a disciple of Socrates, and Athens was at that time thoroughly degenerate. Mob rule prevailed, and sophism, the current philosophy, had for its supreme law of action the individual's natural disposition, his impulses. Aristides, a most estimable citizen, was banished by popular vote for no other reason than that people were tired of hearing him called 'the Just'. Oratory achieved an importance not since attained except during the French revolution and at the present time in Russia.

In Athens there were no intellectual amusements until there arose a game called 'dialectics', in which one man stopped another, as the Ancient Mariner stopped the Wedding Guest, and put to him a question that he must answer 'Yes' or 'No'. Then followed other questions and answers, until one or the other confessed defeat. Schools were started where this game was taught and books were written giving rules for the game. Aristotle was one of the many teachers of the game, and his book was considered about as Hoyle's 'Games' is with us. Time has shown that Aristotle's book, written under these unfavorable conditions, developing deductive logic, is one of the most splendid achievements of the human mind. Socrates put aside all natural science except as to final causes. His work was the moral regeneration of Athens, and if the millions of people who lived during the many centuries between Aristotle and Galileo had not wit enough to detect the error as to falling bodies, the fault lay with them. The submersion of the Ionian induction by the flood of Athenian deduction was a deplorable disaster to science, and it retarded the progress of scientific thought by over 1500 years.

All of this is preliminary to the consideration of the new book on flotation, in which Mr. Ralston gives a list of the various inventions in connection with bubble flotation, many of which he says were designed to avoid infringement. As far as can be judged from reading the descriptions, they did not succeed. Those of the first group include the mechanical frothers and the subaeration machines. Of the second group are the pneumatics, including the Callow and others that would probably have infringed the Callow if this had not already infringed the Minerals Separation. Of all these processes and patents only one, the Minerals Separation, collects tonnage-royalty. The others sell their machines at high prices leaving the purchaser full owner, with no further obligation, except to pay to the Minerals Separation such damages as may be assessed against him for infringement of patent No. 835,120.

Mr. Ralston also mentions a third group, if a single patent may be called a group. He says: "Dudley H. Norris invented the 'pressure' machine shown in Fig. 31." This patent is really only supplementary and shows a separation box, much like the Callow, adapted to the Norris process. There is also the Elmore vacuum with a minus pressure and these two are alike in that they

get their bubbles by reason of a reduced pressure. H. Hardy Smith also mentions "Mr. Norris's unique process, in which minute bubbles are 'born' in a pulp which is super-saturated with a gas." The only gas mentioned in my specification is air, but it may be called 'unique' for the added reason that it is the only process that has been attacked by the Minerals Separation and come off victorious.

When I filed my original application in Washington the examiner in the Patent Office criticized my use of the word 'nascent', just as Mr. Smith does now. I answered that as there was no chemical action, there could be no chemical nascent state; but that there was also in nature a physical nascent state, and that when bubbles formed out of solution, as in the Elmore vacuum and the Norris processes, they had a vigor of action at the instant of nascence that was immediately lost; that if at that instant a metallic particle came in touch with the nascent bubble they stuck together, otherwise there was no flotation by that bubble. With that explanation the examiner allowed the specification to stand.

The explanation seemed at the time entirely commonplace. This was in 1906, and in those days the Minerals Separation had not developed its process, and Callow was far in the future. By 'flotation' one could only mean the Elmore vacuum process. But now that other processes have come into vogue, and no other explanation seems to be forthcoming, it may be worth while to see if there is anything in the notion of a physical nascent state. Mr. Coghill said in another connection that my theory that "each molecule of water is drawn toward the centre of gravity of its mass cannot be taken as a substitute for the accepted theory of surface-tension, for it is not in accord with physicists here or abroad." I recognize the overwhelming force of this argument, just as Galileo did about the falling bodies, but the world moves notwithstanding. At any rate my idea of water forming a sphere when acted on by its own molecular force alone agrees with Empedocles, and I certainly prefer that to Jones's definition: "potential energy, present at the surface of liquids, produces a tension which is known as surface-tension." Webster defines potential as "existing in possibility, not in act." So that the definition becomes "an energy that might possibly exist at the surface of liquids, but in fact does not, produces a tension which is known as surface-tension;" which, after all, is just about my idea of surface-tension.

In the Minerals Separation process the air seems to be drawn in by friction rather than beaten in by blows, and as they are carried around the bubbles become elongated and finally torn apart. When these ruptures or solutions of continuity take place and there happens that a particle of valuable mineral is at the point of rupture, at the instant of rupture the essential act preceding flotation takes place, in the same way as in the two pressure processes, and it is only with the junction of the mineral particle and the broken bubble that flotation ensues.

The same with the Callow process: With a gentle pressure of air the bubbles are few in number and of large size. With more pressure the bubbles are smaller and vastly more numerous. The function of the canvas cannot be to make fine bubbles, for it does not do that. The elongated bubbles break off at the canvas and the union with the metallic particles takes place then and there, or not at all. That is, if there is anything in the idea of a physical nascent state.

From Mr. Free's admirable article on 'Colloids' it might easily be that these show evidence of a physical nascent state. Of course, the difference between what we call 'physical' and what we call 'chemical' does not exist in nature. It is one that we make for the convenience of work and study; the line between them is broadly rather than sharply marked. I have never been able to find a thoroughfare through this border-land and the idea of a physical nascent state may point a way.

With regard to Stokes' formula for falling bodies, quoted by Mr. Free:

$$v = \frac{2}{9k} r^2(d - d')g$$

in which v is the velocity, r the radius of the particle, d and d' the densities of the particle and the medium respectively, and k a constant, depending on the viscosity of the solution, Mr. Free says that the smaller particles fall more slowly than the theory calls for. The square of the radius would be correct if the rate of fall were proportional to the cross-section of the particle; whereas, if the rate were proportional to the mass, as may easily be the case, it ought to be the cube of the radius.

The specification of the Elmore vacuum patent said that bubble-flotation processes are improved in the respect that a smaller proportion of oil or acid may be used by conducting the processes under a reduced pressure; but his claim called for the use of only such pressures as were below that of the atmosphere, although his discovery included all possible higher pressures. Any flotation that might be produced by these pressures above atmospheric normal were at the service of any one who might claim them. The only difficulty would be to devise a way to utilize these higher pressures as bubble-producers.

At this point happened the incident of the Pullman car wash-basin, mentioned by Mr. Ralston, and the rest was easy. All fresh water is rainwater that has fallen through the terrestrial atmosphere, whose density is measured by a maximum pressure of 15 pounds per square inch. The Norris process takes in all these higher pressures, beginning where Elmore left off. The patent provides for a closed receptacle filled with compressed air into which a fine spray of water is introduced at the top of the receptacle and falls through the compressed air to the bottom of the receptacle, where it forms a solid body of water charged with air. The degree of aeration depends upon the pressure of the air in the receptacle, the fineness of the spray, the distance through which the spray falls, the time consumed in falling, and the temperature.

In his article on 'The Theory of Flotation' Mr. Hardy Smith says, under 'segregation No. 1', that "No amount

of agitation or blowing will produce bubbles of the right kind and number in absolutely pure water. A contaminating agent is necessary." Also, that "the action of certain substances in producing innumerable minute bubbles when air is introduced forcibly into a pulp, seems to be of fundamental importance, since without these bubbles the most common forms of froth-flotation cannot be considered." Referring to the work of Professor Pollock, Mr. Smith says of this all-important subject that "with pure water the bubbles were mostly large, and even the small ones which were instantaneously produced had a tendency to collect together to form large ones."

Any one familiar with the milky appearance of the water in the Pullman car and of the water of the cities on San Francisco bay which get their water-supply from the mountains, knows that the bubbles which cause the milky appearance answer to Mr. Smith's description of "innumerable" and "minute" and that they are produced in pure and uncontaminated water, that they do not coalesce and form larger bubbles but continue to maintain the size best adapted to successful flotation. The same phrase "innumerable minute" exactly describes the bubbles produced by what Mr. Ralston calls a 'pressure' process, meaning the Norris process, which term also designates the Elmore vacuum. In my original specification in 1906 it was called "the continuous action of infinitesimally small nascent bubbles of air," and my idea has always been that the use of oil is merely to make a tougher bubble, give the molecular action what name you please. Mr. Smith also gives it as an established fact that for a bubble and a solid to become attached "so that its film forms part of a continuous film covering both solid and gas, there must be some force that causes rupture of the bubble-film at the point of contact," which seems neither more nor less than actual proof of a principle that appealed to me ten years ago as the theory of a physical nascent state.

I applied for a patent in London and I was notified, later on, that I was opposed by Minerals Separation, of whom I thus heard for the first time. Naturally, I was surprised at this notice as being entirely different from the American practice, with which I was familiar. Rule 15 of the American Patent Office provides that "pending applications are preserved in secrecy." In case of a question as to priority of invention between two parties a proceeding called an 'interference' is initiated by the Patent Office itself and the only question involved in that of priority between the two inventions; but this was no interference, it was called an 'opposition'. I had no desire to engage in a patent litigation in a foreign country and I notified my patent attorneys not to appear. Later on, I received a copy of the decision of the London Patent Office, entitled thus:

> In the matter of an application by
> Dudley Hiram Norris for Letters Patent
> No. 14806 dated 27th June 1907. And.
> In the matter of an opposition by
> Minerals Separation, Limited, to the
> Grant of the Patent thereon.

The first thing to be noticed from the above titles is that "Pending applications are *not* preserved in secrecy" in the British Patent Office: that parties not privy to the application have the right of access to the records and to oppose the grant of the patent or to profit by the disclosure of what in the Washington practice is "preserved in secrecy."

The Elmore vacuum application was filed in London on August 16, 1904, and that of Minerals Separation for the British patent corresponding to 835,120 on April 12, 1905, eight months later. According to the record of events as told by Mr. Rickard in 'Flotation' on page 22, Minerals Separation had been developing the process of the Cattermole patent "when suddenly they happened upon the particular combination essential to the froth-agitation process. Messrs. Ballot, Sulman, and Picard agree in stating that protracted experiments were being conducted in their London laboratory under the immediate charge of Arthur H. Higgins, who had been instructed to try all sorts of variations in temperature, acidulation, oiling, and mixing. Nothing noteworthy happened until the proportion of oil was reduced, whereupon the 'granules' began to rise instead of sink and 'the quantity of floating material increased rapidly when the oil was reduced below a certain point, this point being 0.62% of the oleic acid on the ore.' So testifies Mr. Ballot. Thus happened 'the startling discovery of the agitation-froth process' according to W. H. Ballantyne, Mr. Ballot's patent lawyer. The date was March 3, 1905. Then followed the British patent No. 7803 of April 12, 1905, and the American duplicate, No. 835,120."

That is their story as they themselves tell it. No mention is made in all this of the Elmore vacuum patent, although they were in touch with the Elmores for years, were treated with the greatest frankness, as Stanley Elmore says, and it is incredible that they did not have full information of Frank Elmore's patent activities. There is no reason to doubt that Mr. Ballantyne had the same ready access to the records of the London Patent Office during the pendency of the application for the Elmore vacuum patent that he had in that of the Norris patent.

Elmore adds to his flowing mixture "a substance that has a selective affinity for some of the constituents"; Sulman adds "an oily liquid having a preferential affinity for metalliferous matter." Elmore provides for "a smaller proportion of oil" or acid to be used by conducting the process under a reduced pressure; Sulman specifies "a small quantity of oil;" Elmore had brought down the amount of oil to three pounds per ton of ore; Sulman patented the use of "a fraction of 1% on the ore" or less than 20 pounds. Elmore produces his bubbles by a reduction of pressure below that of the atmosphere; Sulman was not satisfied with the bubbles from the Gabbett mixer but "in an alternative method" produces bubbles by a reduction of pressure, but raises the pressure first to "one or two atmospheres" in one place and to "50 to 100

pounds to the square inch'' in another and then lowers it to atmospheric normal.

The Sulman patent is a curiosity. It shows two figures, the first one being for the process evolved from the Gabbett mixer, and Fig. 2 for the pressure process derived from the Elmore. The original application was divided and the second part was granted as No. 835,479. The curious part of 835,120 is that the part of the first specification, which relates to the pressure process, was allowed to remain in the original specification, but without any corresponding claim. The examiner at the Patent Office should have insisted on canceling the 'alternative' method in 835,120 when the application was divided. The machine shown in the drawing of 835,479 is a thing of shreds and patches. It never could run and it never was expected to run. Like many such, it was merely intended to accompany the specifications. Neither Mr. Higgins nor any other man with any experience in a concentrating mill could have designed it.

And yet, Mr. Williams, for the plaintiff, in the Butte & Superior case, had the nerve to bring this monstrosity to the attention of the Court. He spoke of a spitzkasten-classifier, an agitation vessel, a ''suggestion'' of a shaking table, also another ''suggestion'' of another method of treatment which he endowed with the agitation-by-aeration feature of the pneumatic cells, and finally ''the gas was generated throughout the mass at once, sweeping to the surface thereof all the metalliferous matter in the form of a froth.'' No wonder the Court asked if that was in the patent in suit and Mr. Williams answered that it was, but at the time of the Hyde case they had not then found out how to use it. He might have added ''nor yet.'' And still the Court was not satisfied, and said: ''You don't mean it is claimed in the patent in suit?'' and finally Mr. Williams read to the Court claim 1 of 835,120, which has absolutely nothing to do with the 'alternative' process.

The claims of patent 835,479 are three in number:

Claim 1 says: ''The process of separating powdered minerals from one another which consists in suspending the powdered minerals in a liquid, subjecting the mixture to a gas pressure and thereafter relieving the pressure whereby bubbles of gas are liberated in the pulp and carry certain minerals to the surface;'' claim 2 is the same except that it adds ''a small quantity of oil'' to the mixture; and claim 3 repeats claim 2 and adds that the pulp is run out into a separating-box. Claim 1 uses no oil; claim 2 uses ''a small quantity of oil'' the same as in the claim 9 of 835,120 that the U. S. Supreme Court held invalid, and claim 3 uses a spitzkasten, or separation-box, which surely is no novelty.

Mr. Choate said that in matters of litigation it was not enough to know the law, one must sometimes know the judge; meaning that the personality and psychology of the judge is often as essential in a case as the law and the evidence. The legal profession, including the judiciary, are trained exclusively in deductive logic. The existing body of jurisprudence, including the common law, the statutes, and the decisions of the higher courts, forms the major premise; the case at bar, the minor premise; the judge applies the rules of the science and the conclusion is the decision of the Court, or the basis of it. Where, as in a case involving scientific experiments or physical tests, the logic to be applied is inductive, which may be said to give the conclusion and one premise, to find the other, it seems like going backward and the Court balks. Judges are not wise above that which is written and a good strong patent specification is worth a wilderness of physical tests. Courts are suspicious of such tests; afraid of being deceived, intentionally or by reason of the unconscious bias or one-sidedness of the expert making the test. Any word or phrase that will enable him to apply the predicables of Aristotle and the canons of the syllogism and decide the case without considering the physical tests, will receive the judge's instant and welcome attention. In confirmation of the contention that this tendency of the judicial mind goes with the deductive habit of thought, there is the curious parallel between the uniform course of the courts in the flotation cases and the decision of Aristotle, the father of the deductive logic, in the case of the falling bodies.

In the Callow specification it was stated that in the previous art of flotation ''the mixture is then subjected to a violent agitation by means of mechanical propellers'', which was an erroneous statement, as the specification and claim of 835,120 said nothing about mechanical propellers. Then, later on, the Callow specification says, ''a more or less violent agitation or ebullition takes place and a froth begins to generate and to finally rise and form on the surface of the pulp.'' A confession of infringement hardly could be expressed in terms more explicit.

It has been a great misfortune that the Elmore vacuum patent was not before the courts. It would have prevented the continued laudation of the Minerals Separation, culminating in the U. S. Supreme Court's ''Into this field of investigation came the patentees of the patent in suit'' and a lot more of the same kind. But, Elmore chose his own share of his discovery and took only that part below atmospheric pressure, and evidence as to the higher pressures would not have been material to the issues involving 835,120, which agitates to form a froth; but, with the pressure-processes in suit the Elmore vacuum patent, antedating 835,120, would be very material to the new issues; and while the Elmore vacuum does not claim the higher pressures, above atmospheric normal, it specifies these higher pressures and the Norris process claims them; and as against that claim 835,120 could not be effectively pleaded, but only 835,479, which is no process at all and, moreover, it was decided in the British Patent Office that the Norris basic patent did not infringe the Minerals Separation patent and this decision was affirmed on appeal and these proceedings were on the merits and before a competent tribunal and the Minerals Separation was represented. So that, this decision might easily be held to be, as between the same parties or their legal representatives, *res judicata*, and not to be re-opened collaterally.

Efficiency of Gravel Pumps

The following details of the gravel-pumping plant at the Heawood tin mine in the Federated Malay States are taken from a paper by J. J. Garrard published in Bull. No. 156 of the Institution of Mining and Metallurgy. The plant consists of two monitors and an 8-in. gravel-pump driven with a long belt by a Pelton wheel. The material is elevated into a two-compartment sluice-box. The Pelton wheel is above the sluice-box, and the discharge water is used for 'cleaning up,' the boxes being streamed down on separate days, and also to assist in the sluicing when the two compartments are running at the same time. The size of the Pelton wheel is 24 in., and the nozzle is controlled by a needle valve having a maximum size of 1⅛ in. The gauge-pressure is 220 lb. per sq. in., the nozzle being 6 ft. 6 in. above the gauge.

Effective head = 508 – 6 ft. 6 in. = 501.5 or say 500 ft.

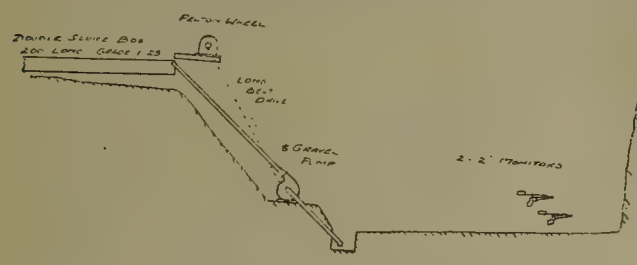
Measurements of the water were taken at a rectangular weir, 20 in. wide, at the discharge of the wheel, the depth of the water flowing over weir being 5⅛ inches.

Quantity of water = $4.67 \times 20 = 93.40$ cu. ft. per min.

Theoretical hp. =

$$\frac{\text{weight of water (lb.)} \times \text{effective head (ft.)}}{33000} = \frac{93.40 \times 62.5 \times 500}{33000} = 88.44$$

The gravel-pump lifts the water and solids from two 2-in. monitors at 65 lb. pressure and also an estimated



ARRANGEMENT OF PUMP INSTALLATION

quantity of 20 cu. ft. per min. of seepage water. The duty of the monitors is shown below:

Nozzles	2—2 in.
Pressure	each 65 lb. per sq. in.
Effective head	150 ft.
Discharge	$2 \times 120.9 = 241.8$ cu. ft. per min.
Seepage	20 cu. ft. per min.
Total water raised	261.8 cu. ft. per min.
Yardage cut (monthly survey)	18,000.0 cu. yd.

The ground treated is a soft clay soil containing about 50% sand; 9.67 cu. ft. of water per min. is required to break down 1 cu. yd. of ground per hour.

The determination of the mechanical efficiency of the gravel-pump is as follows:

Size	8 in.
Speed	482 r.p.m.
H = height lifted in feet	45.7 ft.
Q = cu. yd. per month (solids)	18,000.0 cu. yd.
G = cu. yd. per hour (solids)	25.0 cu. yd.
S = cu. ft. per min. (solids)	55.5 cu. ft.
W = cu. ft. per min. of water lifted (2—2 in. monitors at 6 lb. + 20 cu. ft. seepage = $120.9 \times 2 + 20$)	261.8 cu. ft.
T = theoretical hp. (Pelton wheel 93.40 cu. ft. per min. at 500 ft. (effective head)	88.44 hp.
P = brake-hp. (at 75% efficiency)	66.33 hp.

Overall efficiency of plant =

$$\frac{\text{work done}}{\text{worked applied}} = \frac{H(62.3\,W + 100\,S)}{T \times 33000} = \frac{H(62.3\,W + 45\,G)}{T \times 33000} = \frac{45.7\,(62.3 \times 261.8 + 45 \times 25)}{88.44 \times 33000} = \frac{796785.90}{2918520} = 0.2730 = 27.30\%$$

Mechanical efficiency of gravel-pump, including long belt-drive (efficiency of Pelton wheel estimated at 75%) is:

$$M.E. = \frac{27.30}{75} = 36.40\%$$

A series of tests showed that a gravel-pump driven with a belt by a Pelton wheel will have an efficiency of 27%; when water-power is converted into electricity the gravel-pumping plant-efficiency will be 23%. At least 15% efficiency may be expected from a hydraulic elevator. The system installed will depend, among other things, upon the configuration of the ground and the quantity and situation of the water-supply.

ADVICES from London give last month's shipments of nitrate from Chile as 285,000 tons, 96,000 tons going to Europe and 148,000 to the United States. The exports to Japan, Siberia, and other countries were 41,000 tons. It is interesting to note that in October, 1913, the year before the War, 260,000 tons of nitrate was shipped to Europe in anticipation of the agricultural season, and only 46,000 tons to the United States. In the same month, in 1914, after the commencement of hostilities, the respective quantities were 49,000 and 13,000 tons, the article having been declared "contraband of war," and the principal continental markets being closed. The production of nitrate of soda, notwithstanding the supposed scarcity of fuel, is above that of peace times, last month's total being no less than 258,400 tons, compared with 229,990 tons in October, and stocks in Chile reduced to the extent of 32,000 tons by the excess of exports, are now over 850,000 tons. This being 100,000 tons more than at this time last year, there is some difficulty in explaining the advance in the f.o.b. price from 9s. per quintal 12 months ago to about 16s. at the beginning of last month. The speculative spurt has, however, since died out, the sale of the German stocks having knocked the bottom out of the market, and prices on the West Coast are, at the time of writing, quite nominal. Business on the side has been brought to a standstill by Government control, and further official notifications in the shape of maximum prices or permits are awaited by the trade. Present prices for nitrate of soda at New York are $4.50 to $4.60 for 95% material.

Sea-Water for Flotation

BY AN OCCASIONAL CORRESPONDENT

There is being developed, in an experimental concentrator in the North-West, an interesting departure from standard practice in the flotation-concentration of copper ores.

These ores contain, as the valuable mineral, cupriferous pyrite, accompanied by barren pyrite and by pyrrhotite, in a schistose gangue. Efforts are being made to develop an efficient process by which the cupriferous pyrite may be floated, not only selectively from the gangue, but preferentially from the pyrite and pyrrhotite.

While much valuable work has been done with oils, particularly with straight Californian fuel-oils, it is the purpose of this article to describe results obtained without the use of oil or similar substances. These results appear to upset many pet theories heretofore advanced, particularly the contention that selective flotation results from the coating of sulphide minerals by oil, and that froth results from a lowering of the surface-tension of water.

Briefly, the process consists in circulating and aerating an ore-pulp containing an electrolyte in solution, no oils or oily substances being present. The original discovery, on which this process is based, was made on March 5, 1917, when a laboratory test was made using commercial waterglass in the proportion of about 5 lb. per ton of ore. The test was made upon an ore containing about 3% cupriferous pyrite and 11% pyrrhotite, assaying 0.74% copper, 15.6% iron, 5.5% sulphur, and 54.4% insoluble. From 500 grammes of ore, 12 gm. of concentrate was obtained, assaying 16.70% copper, 38.3% iron, 41.4% sulphur, and 2.3% insoluble. No single particle of pyrrhotite in the concentrate could be detected with a microscope.

This discovery was not followed up at the time owing to press of other work, but a little later, while some tests were being made on the use of oil with salt water, it was found that the salt solution gave a similar preferential flotation of cupriferous pyrite. Other electrolytes were then experimented with, including sodium sulphate, carbonate, bi-carbonate, sulphite, and thio-sulphate; magnesium chloride and sulphate; calcium chloride and carbonate; ammonium chloride and carbonate; sulphuric acid; and other substances. In general it appeared that chlorides gave the best results. For example, the following are the results of some tests made in a Janney laboratory machine upon an ore containing about 7% cupriferous pyrite and 9% pyrrhotite, assaying 1.75% copper, 18.9% iron, 5.9% sulphur, and 47.4% insoluble.

A. Ordinary Tap-Water Plus 15 Gm. Sodium Chloride

Product	Weight Gm.	Assay, % Copper	Iron	Sulphur	Insoluble
Concentrate .	56	15.35	28.3	23.9	16.6
Middling	24	0.72	32.5	15.1	30.4
Tailing	417	0.07	16.4	3.2	53.4

B. Ordinary Tap-Water with 30 Gm. Magnesium Chloride

Product	Weight Gm.	Assay, % Copper	Iron	Sulphur	Insoluble
Concentrate .	33	23.68	31.3	29.4	5.4
Middling	29	1.32	27.0	10.6	32.4
Tailing	440	0.26	16.7	3.8	51.4

C. Ordinary Sea-Water to Which No Reagent Was Added

Product	Weight Gm.	Assay, % Copper	Iron	Sulphur	Insoluble
Concentrate .	39	21.61	34.3	31.2	6.4
Middling	39	0.71	34.9	16.2	26.0
Tailing	421	0.09	15.2	2.6	56.6

Two short trial runs have been made in the experimental concentrator, using salt in place of oil, in a unit consisting of one Janney emulsifier and six regular Janney cells. The cells were emptied and washed out with a hose, then allowed to fill with fresh pulp. When full, and circulating properly, salt was added by dumping a half-sack at a time into the emulsifier. A rather meagre but exceptionally clean mineral-froth immediately appeared. When the entire machine was operating smoothly, grab-samples were taken of the froth from each of the six cells, and of the tailing. Assays were as follows:

Product	Assay, % Copper	Sulphur	Insoluble
Froth-cell No. 1.....	12.20	29.0	19.2
Froth-cell No. 2.....	16.48	32.2	6.2
Froth-cell No. 3.....	16.00	29.6	7.6
Froth-cell No. 4.....	8.92	...	...
Froth-cell No. 5.....	10.28	...	...
Froth-cell No. 6.....	5.04	...	...
Tailing	0.21	6.3	...

The mill-heading for the day on which this test was made assayed 1.24% copper, 19.0% iron, 9.9% sulphur, and 44.4% insoluble. Attention is particularly directed to the large amount of sulphur remaining in the tailing, from which the copper has been quite well removed.

Another similar run was made at a later date upon a more difficult ore, assaying 2.21% copper, 26.0% iron, 21.1% sulphur, 34.0% insoluble. The machine was not circulating as efficiently as when the former test was made and for this, as well as other possible reasons, a clean tailing was not made. For the entire shift, when salt was being used, the concentrate assayed 13.56% copper, 26.9% sulphur, and 16.2% insoluble, the return middling 6.0% copper, and the tailing 0.77% copper

and 15.7% sulphur. Grab-samples taken at a time when the machine was operating at its best gave the following results:

Product	Assay, % Copper	Sulphur	Insoluble
Froth-cell No. 1	20.08	29.8	7.0
Froth-cell No. 2	14.68	25.9	11.0
Froth-cell No. 3	15.64	27.6	9.6
Froth-cell No. 4	13.60	25.3	13.8
Froth-cell No. 5	16.08	26.1	10.8
Froth-cell No. 6	13.32	26.9	10.8
All froth to thickener	17.76	28.6	13.0

The concentration of the salt in the pulp-water was slightly higher than in normal sea-water.

Not only do these inorganic salts give a more markedly preferential flotation of the cupriferous pyrite, but, there being no oil in the froth, it breaks down readily and does not accumulate on thickeners as oil-froths have a troublesome habit of doing. The concentrate is usually cleaner of gangue than when oils are used.

Some few experiments have been made on other than chalcopyrite ores, with rather poor results. Tests were made upon an ore containing both chalcopyrite and bornite. A practically complete flotation of the former was made, but the latter was hardly affected. A test was made on a 'porphyry' copper ore containing chalcocite. A voluminous froth was formed, but it was non-selective. It appears that the nature of the gangue has an important bearing on the flotative effect of these reagents. For example, poor results were obtained in attempting to float pure clean chalcopyrite from a pure clean quartz gangue. Much work remains to be done to prove the limits of applicability of this process, but in the case of ore deposits adjacent to the ocean, or to inland saline waters, there are attractive possibilities in the way of increased metallurgical efficiency, saving of oil, and freedom from annoyance by the owners of oil-flotation patents.

Arizona Mine Output 1917

The output of gold, silver, copper, lead, and zinc from Arizona mines in 1917, according to Victor C. Heikes, of the U. S. Geological Survey, had a total value of over $214,000,000, an increase of more than $23,000,000 over the value of the output in 1916. This increase was due in part to the greater prices of metals, all of which, except zinc, were decidedly higher in 1917. In quantity there was a marked increase in gold, a slight increase in recoverable zinc, but decreases in silver, copper, and lead. During the early part of the year Arizona was producing copper at a rate decidedly greater than in 1916, but labor strikes at the main producing and smelting localities considerably reduced the rate before the end of the year. Many mills were built, among them a custom-mill at Chloride and a sampler at Wickenburg. Construction was begun on the new smelter for the United Verde Extension Co. at Jerome. The capacity of the Arizona Binghampton mill was increased to 250 tons per day.

The production of gold from Arizona mines increased from $3,985,559 in 1916 to $4,831,000 in 1917. As the production of copper ore and of lead ore were much less than in 1916 the increase in the output of gold can be credited to the San Francisco district, of Mohave county, and largely to the United Eastern property, which, during the year, became the leading producer of gold in the State. The Gold Road mill was idle and the Vulture property was operated only a little. Production at the Tom Reed was upheld, and considerable gold was produced from the Copper Chief mine, in the Verde district.

The mine output of silver decreased from 7,212,039 oz. in 1916 to about 6,354,000 oz. in 1917, a decrease of about 858,000 oz. In spite of this decrease, the improved price of silver, which averaged 81.4 cents per ounce, brought the value of the output to about $5,000,000, an increase from $4,745,522 in 1916. The decrease in quantity was due to decreased shipments of lead ore and copper ore.

The mine output of copper was about 688,000,000 lb., a decrease of 34,000,000 lb., or nearly 5%. Arizona is still the leading copper-mining State and produced more than twice as much copper as Montana. The value of the output increased from $177,570,960 in 1916 to over $200,000,000 in 1917. Six of the large copper-smelting plants reported decreased outputs on account of labor troubles. Five others, however, greatly increased their copper production: the Hayden, Sasco, United Verde, Consolidated Arizona, and Calumet & Arizona. At the New Cornelia property the new leaching plant was started in June and produced more than 2,000,000 lb. per month until the end of the year. Some copper matte was shipped from the Great Western smelter, in the Big Bug district. The International Smelting Co. increased its capacity by adding a reverberatory furnace.

The mine production of lead in Arizona decreased from 27,062,087 lb. in 1916 to about 18,000,000 lb. in 1917, but as the price was better the value was only slightly less than that of 1916, which was $1,867,284. Most of the lead ore came from the Warren district, of Cochise county, and the Wallapai district, of Mohave county. Considerable lead ore was shipped from the Bunker Hill mines, in the Tombstone district.

The output of recoverable zinc was about 20,700,000 lb. in 1917, an increase of about a million pounds. The two largest producers were the Union Basin property and the Tennessee mine, both in the Wallapai district, of Mohave county. The Arizona Hillside property, at Hillside, shipped considerable quantities of zinc ore for the first time, and the properties operated by Randolph & Gemmill at Crown King also made some shipments. Zinc was shipped from the Duquesne property, in Santa Cruz county. Smaller shipments were made from Wallapai district and from Globe, Patagonia, Pearce, Tucson, and Casa Grande. The mill of the Union Basin property was burned in October.

The dividends for eleven months from Arizona properties amounted to more than $41,000,000.



MAMMOTH, UTAH

ORE SHIPMENTS.—EMPIRE MINES.—IRON BLOSSOM.—KNIGHT MINES.—UTAH MINING CO.

Owing to inclement weather and an accident to the main-line switch the shipment from the Tintic district is far below normal for the week ended January 18; the total being 141 cars as compared with 175 of the previous week. The shippers were: Dragon Con. 31 cars, Chief Con. 15, Iron Blossom, 15, Gemini 13, Centennial Eureka 12, Mammoth 12, Grand Central 11, Eagle & Blue Bell 11, Tintic Standard 6, Gold Chain 4,



MAP OF UTAH

Victoria 2, Tintic Milling Co. (bullion) 1, Eureka Hill 1, Victor lease 1, Yankee Con. 1, Chief Con. (manganese lease) 1, Iron King 1, Minnie Moore 1, Colorado 1, Empire Mines 1, making a total of 141 cars. Two important pieces of development work are under way in the main section of the Empire Mines property, which is a consolidation of a half dozen large tracts of mineral ground in the central part of this district. This work is being done through the old Lower Mammoth shaft and conditions are encouraging both on the 1500 and the 1800-ft. levels. On the 1500-ft. a drift is being run into new territory west of the shaft and the 1800-ft. drift is headed out toward the east. There is little leasing in the Lower Mammoth part of the Empire ground but over in the Carisa section lessees are operating four or five blocks of ground at a profit.——At a recent meeting of the Chief Consolidated directors the regular dividend of 5c. per share and an extra dividend in the same amount were declared, payable in February. Cecil Fitch, superintendent for the Chief Con., left early in the week for Michigan to attend a meeting of the directors of the company. ——By the end of January it is expected that the No. 1 shaft of the Iron Blossom company will have reached a depth of 2200 ft. where sinking will be stopped and preparations made for the thorough prospecting of the ground. In the north end of this mine, at the No. 3 shaft, considerable copper ore is being mined from the 900 to the 1200-ft. levels. The drift from the 1700-ft. level, driven over into the Tintic Central, is cutting a likely looking section of the ground. The drift has been in a loose cavy formation, which is iron-stained and has other indications of the more valuable minerals. This mine shipped 15 cars of first-class ore this week.——On January 11 and 12 there was a shortage of electric power in the Tintic district, due to a temporary difficulty at the Provo plant of the Utah Power Co., and as a result the crushing plant of the Tintic Milling Co. was closed down for the two days, but it did not affect the other part of the mill.

The officials of the Knight companies state that satisfactory progress is being made at the drain-tunnel which will be driven from the south-west of Elberta on the Goshen slope to the heart of the Tintic mining district, draining the properties controlled by Jesse Knight as well as other South Tintic mines. Work was taken up late last year but three or four months were required to erect the necessary buildings and machinery. Work in the tunnel commenced only a short time ago but owing to the soft ground rapid work has been possible.——The Utah Mining Co. at Fish Springs has passed into the hands of Daniel Livingston and J. A. Rich, who will erect a concentrating plant to treat the many thousands of tons of low-grade ore. The property is a considerable distance from the railroad and at the time the mine was paying its big dividends no effort was made to handle anything less than $100 ore, consequently the dump contains considerable good ore.——Four carloads of ore were shipped last year from the Eighty-Eight property and the Desert Mountain shipped the same amount. The latter mine is splendidly equipped for deep work. The Deseret Mountain shaft has reached a depth of 350 ft., where a large body of low-grade copper ore was found.——As a result of the heavy snow-storm of the early part of the week, the hauling of ore from the Iron King property was suspended, but will be resumed in the near future. The ore which is now being shipped from this mine is an iron ore, which the smelters are using for fluxing purposes.

MAYER, ARIZONA

CONSOLIDATED ARIZONA.—DESOTA.—BARBARA.

The Consolidated Arizona Co. will spend $50,000 on the further development of the Blue Bell mine this year. The new work will consist of diamond-drilling horizontally on the lower levels, running a drift on the 800-ft. level at the south end of the mine to tap the ore that has recently been opened at 75 ft.,

and doing further work on the new 1200-ft. level. Already the new work on the 1200-ft. level has cut the big orebody that furnished a third of the output of the mine last year on the 1000-ft. level. In the drift that is being run north from the shaft at 1200 ft. the south end of the lense of ore has been struck and followed about 75 ft. At the south end on the 1000-ft. level this orebody tapers down, but on the 1200-ft. level, it is widening as the drift goes north. So far the orebody is 15 to 16 ft. wide and runs 4 to 4½% copper and $6 to $8 in gold and silver, which is slightly richer on the level above. The output for the past year was 100,000 tons.——At the DeSota mine, owned by the same company, the shaft will be sunk to 300 ft. While this mine is only about three miles south-west of the Blue Bell, it is found that the ore is more silicious and about the same richness. The ore lenses, though not so long, are thicker and are more numerous. The mine produced 50,000 tons last year.——Between these two mines there are several properties that show an outcrop indicating that the ore may be found in the same courses as in the mines at each end. The Blue Bell Extension Copper Co. began to sink a shaft a short distance over the south of the Blue Bell line last week. The company was organized by J. E. Garber, who is president, and C. J. Murdock, who is vice-president; both have been in the employ of the Consolidated Arizona Co. at the Blue Bell mine for several years. The work at the shaft is in charge of C. J. Murdock.

Probably no strike of ore at Mayer has been heralded with so much enthusiasm as the one just made in the Binghampton mine. In a drift run north 1400 ft. from the main shaft on the 100-ft. level ore has been cut and followed about 20 ft.; assays run from 4 to 23% copper. It is in an entirely new ore-zone, the nearest orebody being 800 ft. away. On the 600-ft. level, a drift run south struck the extension of the large ore-lense on the 400-ft. level. Face samples run from 6 to 27% copper. Diamond-drilling on this level is blocking out an orebody recently determined to be 30 to 50 ft. wide. It is estimated that the mine has five years of ore in sight at the present capacity of the mill, which is about 200 tons daily.——The taking over of the Barbara mine by the newly-organized Monte de Cobre Copper Co. was completed this week. The officers are: President, W. A. Tucker, of Bisbee; vice-president, John Ross, of Bisbee; secretary, E. M. Walker, Mayer; and treasurer, J. R. Robertson, Mayer. For the past four months the development of a large group of claims at the south end of Copper mountain has been in progress, the capital having been furnished by the Bisbee people. A cross-cut adit has already passed through about 40 ft. of poor-grade vein-matter.

PLATTEVILLE, WISCONSIN

Hird Mines.—New Zinc Deposits.—Blewett Mining Co.

The Frontier Mining Co., operating the Calvert, Bull Moose, Burr, Middie, Grotkin, and Hird No. 3 and 4 mines, all under the management of J. H. Billingsley, offers one of the most interesting mining combinations known to the Wisconsin zinc field. A new basin has been opened at the Calvert mine which yields 150 tons of 40% zinc concentrate weekly. The Bull Moose is opening a new range east of that now followed and anticipates an output of 250 tons of 42% zinc ore weekly; the Burr is opening a basin, containing several months run, on the Schultz allotment. Several borings have been made recently, but these have not been sufficiently good to warrant sinking. The Middie, a new producer, was equipped with surface rig about mid-summer, and is giving a splendid account of itself in a weekly yield of 250 tons of 45% zinc ore. The Grotkin is now being developed; the ore will be trammed underground with gasoline locomotives to the Bull Moose mill. The Hird mine No. 3, known locally as the Bearcat mine, is a recent acquisition to the producers the Frontier Co. is now operating, and is yielding 200 tons of 25 to 30% zinc ore weekly. In a recent interview the general manager expressed the belief that the grade of ore will improve as the lode is followed into the hanging wall, the mine having been opened back of the foot-wall. The Hird mine No. 4 is being permitted to rest, pending more favorable conditions for working low-grade ore. The company is engaged with drill squads on the Treganza, Jim Calvert, Robson and Rundy leaseholds, in the Benton district, on the Grotkin at Leadmine, and at the Merry Widow mine and Virtue and Kneebone leases in the Galena section. Labor conditions are pronounced adequate, but many of the more skilful men are now in the United States army.——J. H. Billingsley advises that following the snowstorm that was general over the field recently, all teaming was abandoned for a whole week, the snow being 10 ft. deep on the east and west roads. Complaint was made that no assistance was rendered by local authorities, though mining companies pay thousands of dollars in taxes annually. On account of the blockade the Frontier company carried over at the week ended January 12 more than 1000 tons of milled ore. Electric-power service has been good considering the fierce battle raged against the elements. On the Hughlett and Kneebone leases it is said promising prospects have been proved by drilling.——A new mining company with a capital of $100,000 has been organized under the laws of Illinois at Galena; it will be known as the Blewett Mining Co. A large body of zinc ore has been developed on this land, one-half mile south of the city of Galena, Illinois. Work has been started on a new shaft and a mill-building is planned just as quickly as the ground has been opened. The board of directors for the first year are E. Blewett, W. Westwick, C. Moores, R. I. McKee, and J. H. Billingsley.

TORONTO, ONTARIO

Government Ship-Building Plans.—Dome Mines.—Kirkland Lake.—Boston Creek.—Nipissing.

The Canadian government has announced a plan for national steel-ship construction on an extensive scale, involving an expenditure of between $50,000,000 and $60,000,000 per annum. It is proposed to utilize to its full extent the capacity of existing shipyards, where a large number of ships are now being constructed both for the British government and foreign registry. After these contracts are completed no further ship-building for registry abroad will be allowed until the end of the War, or for some time thereafter, and all construction will be done by the Government. Charles Duguid, naval architect for the Government, who has had a lengthened practical experience in British shipyards, will be in charge. An important feature of the plan is the establishment of rolling-mills for the production of steel plates and shapes, which cannot at present be secured in any quantity from the United States, owing to the pressing domestic demand. These rolling-mills will be started in connection with the steel plants at Sydney and New Glasgow, Nova Scotia, Sault Ste. Marie, Ontario, and possibly at other places. The maximum capacity of the shipyards to be taken over is estimated at 300,000 tons per annum. The shortage of steel, caused by the great demands of the munition plants, which are now receiving orders to the value of $30,000,000 per month, is severely felt by the railroads, which are badly in need of supplies of rails for track maintenance.——The Canadian Railway War Board, a recently constituted body representing the principal railroad companies, organized with the object of meeting the emergencies created by the War, has decided that it would be advisable, in view of the impossibility of obtaining rails otherwise, to tear up 1500 or 2000 miles of the less important lines, and use the rails for the requirements of the main arteries of traffic. This under present conditions is a somewhat large order, as it is estimated that 20,000 laborers would be required for the work with none at present in sight. The Railway War Board has therefore recommended

that the Government secure Chinese labor, by detaining the coolies who are passing through Canada to work on the western front overseas. This proposal is, of course, strongly condemned by the labor unions, and is hardly likely to be entertained by the Government. The labor shortage is steadily growing more serious, affecting all lines of industry; and all sorts of propositions and suggestions as to a remedy are being mooted, that finding the greatest favor being the industrial conscription of aliens, enemy or otherwise, for use in the essential industries at mere subsistence wages. In view of the reported intentions of the Government to take drastic measures in this direction, Premier Borden has issued a statement that all such rumors are unfounded, as the Administration has not as yet even considered the question, though it will take the matter up in the near future. In the meantime Hon. G. D. Robertson has been commissioned to visit the steel and coal plants at Sydney, Nova Scotia, where the output is being considerably curtailed by the shortage of workers, and report on the labor situation there.

Preparations are being made for renewed activity at the Dome Mines, Porcupine; a contract having been let to the Longyear company for sinking the main shaft from the present depth of 1000 ft. to the 1500-ft. level.——The shaft on the Jupiter property of the McIntyre has reached the 1000-ft. level and driving has been started to connect this working with the drift being run from the McIntyre shaft at 1940 ft. distance, along the principal orebody, which is in some places 50 ft. wide. The orebody is stated to have been proved to a depth of 1350 ft. with gold content at that depth averaging $20 per ton.——At the Davidson, a good body of high-grade ore five to six feet wide and 2000 ft. long has been opened on the 100-ft. level. The new mill is expected to be ready for operation early in February.——Operations on the Schumacher are yielding satisfactory results. A vein has been cut at the 300-ft. level, which is stated to assay $8 per ton over a width of four feet. Extensive sampling is being done at the West Dome on behalf of Montreal interests. A mill-run of 1000 tons of West Dome ore will be made at the Dome Lake mill.——The Kirkland Lake mine has been closed on account of severe weather, and will not be re-opened until spring.——The Wright-Hargraves mine has installed new machinery, including a 200-hp. motor, and 12-drill compressors, and is actively pushing development. The shaft of the Teck-Hughes is down to the 500-ft. level, where a large ore-crusher will be placed.——Activity in the Boston Creek district is steadily increasing, the three most promising properties being the Patricia, Miller Independence, and Mondeau. At the Patricia high-grade ore has been proved to continue below the 100-ft. level, and the outlook is highly satisfactory.——The mill of the Miller Independence has been closed until spring, but development is being pushed in the mine. The main shaft is to be continued to 150 ft.——The Mondeau has installed a new steam mining plant.

During December the Nipissing produced ore of an estimated value of $340,793, and shipped bullion from its own and custom ores of a net value of $376,433. Shaft No. 63, which has been idle for two years, is being unwatered for a resumption of operations. New exploration work by means of diamond-drilling will shortly be undertaken.——The Trethewey has purchased a controlling interest in the Castle Mining Co., taking over 51% of the stock of $1,500,000 at 20c. per share. The Castle holdings are adjacent to the Miller Lake-O'Brien of Gowganda.——The Kerr Lake produced 203,048 oz. of silver during December, as against 205,522 oz. in November. The total production for 1917 was 2,599,525 oz. as compared with 2,545,804 in 1916. The payment of its last dividend of 5% will bring its total returns to shareholders up to $7,410,000.

The Canadian government has modified the embargo placed on the export of molybdenum and tungsten, and will permit the shipment of these ores under license to approved consignees in the United States and France. This action is likely to have a stimulating effect on molybdenum mining in Ontario and Quebec, both of which provinces have extensive deposits of this metal. The embargo considerably curtailed the output, as the producers were practically confined to the British market at prices fixed by the Imperial government, which were a good deal lower than could have been obtained in the open market.

VANCOUVER, BRITISH COLUMBIA

THE BRITANNIA.—GRANBY CONSOLIDATED.

During the year 1917 the Britannia Mines on Howe sound produced 18,000,000 lb. of copper, 92,000 oz. of silver, and 900 oz. of gold; a slight improvement on 1916. With the close of the year the general programme of construction was completed, December witnessing the first operation of the new power supply. Now 2000 tons of ore is being treated daily, an increase of 1200 tons over the capacity of the old mill. The oil-



BRITISH COLUMBIA, SHOWING BRITANNIA AND ANYOX MINES

flotation process is entirely satisfactory and is giving an excellent recovery. Production was interrupted by power shortage in the early summer, the result of a lighter rainfall than usual, but the completion of the new power-plant ensures an adequate supply of power during 1918. The installation of this system necessitated the building of a dam on the south fork of Furry creek; from there the water is piped 18,000 ft. to the beach power-house. This work cost $500,000, but a maximum of 4000 hp. and an average of 2000 hp. is provided and the use of fuel thus avoided. The steam plant has been retained as an emergency power plant. A new steamer was bought during the year and 12 storage-battery locomotives were added to the mill equipment. The usual amount of driving and cross-cutting was carried on in the mine and a number of new strikes were made. At the beginning of 1918 the company's ore-reserve is greater than it was a year ago. Plans for the future provide for the continuance of the general policy of development and progress, which was laid down by the late G. B. Schley, who was the president and principal stockholder of the company, and it was due to his faith in the future of the mine that the present success has been reached. The work

at Britannia is in charge of J. W. D. Moodie, vice-president and general manager. E. J. Donohue is secretary-treasurer, and C. P. Browning is general superintendent. During the year the company paid out $1,500,000 in wages and $2,500,000 for supplies. Additional accommodation has been provided for the employees in the form of three new boarding-houses at the top of the hill, which are heated by steam and equipped with baths. There is also a recreation hall where moving pictures are shown.

Already the largest copper mining and smelting company in the British Empire, the Granby Consolidated Mining, Smelting & Power Co., expects to have its new converters at Anyox ready for work by the end of February, which will increase the capacity of the plant from 75,000 to 85,000 tons per month. At present, owing to the lack of sufficient converter capacity, the copper matte has to be run through the furnaces a second time; the first operation gives a 12% matte, which is raised to 25% by the second treatment. Another improvement that is being made at the Anyox plant is the construction of by-product ovens that will produce 350 tons of coke daily from about 500 tons of coal. Machinery for this plant has been ordered, and will entail an expenditure of $1,500,000. All the building material and structural steel will be bought at Vancouver as well as whatever other supplies the city can provide. The company spends some $3,500,000 in Vancouver every year for the regular supplies, so that the construction of the coke plant will mean a large extra expenditure here. To supply coal for the ovens the company recently acquired some coal areas on Vancouver island. Diamond-drilling and other development is now in progress there and it is expected that the property will be ready to ship coal by the middle of 1918. About a thousand tons per day will be mined, half of which will be used at the coke plant and half sold in the open market. A steam-power plant using fuel oil has been erected on Granby bay, where the smelter is situated. The plant includes blast-furnaces and converters, and a sintering plant has just been added. Besides the mines at Phoenix and Hidden Creek the company owns properties in Alaska and at several points along the coast of British Columbia. Its earnings at the present time are between 20 and 30% on the capital stock; dividends at the rate of 10% are being paid and $7,148,056 or more than 50% on the capital stock has so far been paid in dividends. The value of the ore-reserves is estimated at $125,000,000.——The Granby company established a new record at its Anyox plant in December. The production in that month was 3,549,310 lb. of copper, as contrasted with 3,159,284 lb. in May of that year, the banner month up to that time. The total production in 1917 was 40,314,786 lb., of which 7,067,850 lb. was from Grand Forks. This may be compared with a total of 13,710,605 lb. from Grand Forks in 1916.

The Victoria & Island Development Association of Victoria is campaigning energetically for an iron and steel industry on this coast. In a number of places in this Province there are extensive deposits of high-grade magnetite, which, together with the enormous amount of water-power that at present is going to waste, should form the nucleus for a large iron and steel industry.

HOUGHTON, MICHIGAN

UNUSUAL WEATHER.—MINERALS SEPARATION.—MASS CON.—CHEROKEE.—SENECA.

For the first time in 18 years the copper country of Michigan has been shut off from the outside world as far as railway service is concerned. Climatic conditions here are not unusual, looked upon from the standpoint of the local resident, although December and January thus far have been a little colder than usual and the snowfall has been larger than any in past records of the Government office. But this is the first time that no trains have come in from Chicago or Detroit and none has departed. Despite these unusual conditions not a stamp-mill has shut-down. Local railway service has been regular and every mine is supplying its mills with plenty of copper ore for concentration. Local railways are accustomed to handling unusual conditions and have kept the main lines and shaft side-tracks well open all the time. So that this necessary war munition, copper, is likely to be produced during January 1918 at a better rate than in any month for three years.

While there is hope that the flotation process of the Minerals Separation Co. may be applicable to the amygdaloid lodes of the Michigan copper country there really is not much reason for expecting that any large sums will be realized from its practical operation on such sands. Long continued experiments by the Calumet & Hecla interests on their conglomerate sands showed successful results, but on the Osceola sand no such results were secured. Ultimately the Calumet & Hecla will treat all of its conglomerate slime by the flotation process. This includes the slime from the mill-operation as well as the slime from the sand pile, from the lake, and even the slime treated by leaching. It is impossible as yet to give figures on the profits accruing therefrom.——At the White Pine property there are two classifications of the tailing that will be treated by the flotation process. One is the regular slime and the other a grade of light and flaky copper that ordinarily is not saved, but that is caught by flotation. A 50-ton plant was used for an experimental period and now a 600-ton plant is in operation. No other mines in this district have experimented with the process and while some of the concentration experts are planning to try the scheme they are frankly dubious as to its success.

Mass Consolidated is maintaining ore shipments close to 1000 tons per day and today is in a better general physical condition than ever before. Practically all of its underground improvements, with the exception of the motor haulage, have been finished. Of course the elaborate plans for B shaft have not been carried out because the outlay at this time would be too great, and Mass is one of the properties of comparatively limited tonnage and low-grade ore that finds it possible to produce copper at the Government's price only by the best management and the exercise of the greatest economy.——Resumption of operations at the Cherokee can be anticipated when conditions are improved. Suspension was not due to any lack of mineralization in the ground opened or lack of faith in the ground yet to be opened but rather to the difficulties to be found in a small exploration property so far distant from Houghton at this time of the year. The ore taken out and sold ran 87 lb. per ton, an unusual showing, even for selected material. Practically every cross-cut showed ore that offered possibilities for commercial operation.——Work at Seneca was started last spring. It is hoped that hoisting of ore from the shaft will commence next week. While to some this may seem a long time to get a property in shape to commence production, and while it does not indicate that the early promise of getting to the Kearsarge lode and stamping ore in two years is likely to be successful, it must be remembered that unusual hindrances have delayed the work. In addition to the great difficulty in securing even the ordinary mining machinery, building a railroad extension and all the surface buildings, have been carried on under circumstances which were discouraging, to say the least. Plans for the sinking of the shaft with unusual rapidity, upon a new system and by expert shaft-sinkers, promise, now that the shaft-house has been covered in, a burst of speed that will make all former records look insignificant by comparison.——Illustrative of the difficulties that some of the smaller and leaner properties have to encounter, the Franklin now is employing 30 trammers, where formerly they used 120. Fortunately the difficulty does not interfere quite as seriously as one might suppose with the output of ore because the management has a rope-haulage tramming system.



ALABAMA

CLAY COUNTY

(Special Correspondence.)—The Crystalline Flake Graphite Co., Ashland, is erecting a mill in which to concentrate its graphite, and it is expected that it will be in operation by March 15. Part of the equipment has been ordered from the Denver Quartz Mill & Crusher Co., and includes that company's No. 2 mill. R. E. Meade & Co. of Ashland have charge of the construction.

Ashland, January 19.

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—The Dos Cabezos Gold Ridge Mining Co., has decided to erect a 100-ton mill. Considerable development has been done on the property, the ore-reserve being estimated sufficient to supply the proposed mill for 10 years. The Commonwealth mine has been sub-leased. New development work is yielding five tons of ore per month which is being shipped to Douglas. The old tailing is being re-worked and as soon as a new engine is in place the mill will be running to capacity.

Bisbee, January 20.

GILA COUNTY

(Special Correspondence.)—The New Dominion Copper Co. has again been granted permission, by the Arizona Corporation Commission, to sell stock. From the fine showing on the 800-ft. level the company has decided to sink to the 1200-ft. level and discontinue cross-cutting at the 800-ft. level.——High-grade bornite ore, carrying silver, has been opened while cutting the station on the 1000-ft. level of the Iron Cap mine. The cross-cutting which has been done on this level in making the station shows the ore to be at least 10 ft. wide; it assays 12½% copper.——The last 285 ft. of the shaft, being sunk by the Porphyry Copper Co., has been in ore. The company plans to drive at the 530 and 630-ft. levels to the Inspiration boundary on the east and to the western boundary. For 85 ft. below the 475-ft. level good chalcocite ore was cut in the shaft. At the 640-ft. level good ore was again struck.

Globe, January 19.

During last year the Mazatzal Mining Co. did 1600 ft. of development consisting of 1060 ft. of adits, a winze, and several prospecting shafts. Besides this some three miles of road was graded. The mine is situated 16 miles west of Payson, and consists of eighty 20-acre claims. A 15-ft. vein has been opened at a number of points by adits and surface shafts, and two small veins, running as high as $125 in silver and copper, have been cut in one of the adits.

GREENLEE COUNTY

(Special Correspondence).—The Carlisle Mining Co. has surrendered the property to G. E. Utter from whom it was purchased three years ago. It is understood that Mr. Utter will continue to operate the property.

Clifton, January 18.

MOHAVE COUNTY

(Special Correspondence.)—Developments at the Oatman United are encouraging. The cross-cut east toward the Rhyolite Dyke is in 460 ft. The west cross-cut is in 550 ft. at which point a 12-ft. vein was cut.——Development work on the 400-ft. level of the Gray Eagle claim of the Tom Reed has opened two ore-shoots, each 160 ft. long, averaging respectively $14 and $16 per ton. These ore-shoots are separated by a 55-ft. barren zone.——F. T. Torpey, of the Gold Road Bonanza, and associates have purchased the Gold Range property.——The McCracken Silver Lead Mining Co. has driven its adit to the big vein; driving under the ore-shoot exposed at the surface will be started.——The main shaft on the Leviathan mine has reached a depth of 250 ft., where a station will be cut and a cross-cut run to open both veins. A fire occurred in the mill, causing considerable damage, but the delay of a few days only is expected.——The Schuylkill Mining Co., has purchased all of the electrical equipment of the Golconda and is erecting it at the Tennessee mine.

Kingman, January 19.

PIMA COUNTY

(Special Correspondence.)—The new three-compartment shaft on the Southern claim of the New Cornelia is now down 35 ft. Ore was found practically from the surface.

Tucson, January 18.

YAVAPAI COUNTY

(Special Correspondence.)—At a meeting of the directors of the Green Monster it has been agreed to start development work at the old Brookshire workings.——The unwatering of the Storm Cloud mines, near Senator, is completed. The O'Brien Mines Syndicate is arranging to operate the mine.——A gold strike was made recently at the bottom of the 40-ft. shaft on the Blue Jacket gold mine on Lynx creek. The ore-shoot is said to be 12 in. wide and assays $88 per ton.——The holdings of the Arizona Portland company in Copper basin have been sold to the International Syndicate of Mines & Smelters. Two shifts are now at work, machinery has been ordered, a complete electric equipment is to be installed, and all necessary camp buildings erected.——The United Arizona Copper Co., in the Copper Creek district, has cut a body of molybdenite ore on the 630-ft. level. It is claimed that the orebody is 17 ft. wide running as high as 2% molybdenite; 12 inches on the foot-wall runs 30%.

Prescott, January 12.

(Special Correspondence.)—The working-adit of the Arizona Daisy, driven on the Daisy Dell vein, is now in 455 ft. Surveys show that the face is near the rich shoot of ore discovered in the shaft some years ago. The adit opened two other ore-shoots.——A new vein of copper sulphide ore has been cut in the winze from the 600-ft. level on the Calumet & Jerome Copper Co. It is reported that a 6-ft. vein of lead-copper-silver ore, valued at $100 per ton, has been uncovered at the 200-ft. level.——Messrs. Elmer and Warren recently located an old property three miles south of Prescott on which a large body of 8% vanadium ore has been found.——The Copper Chief gold mine is expected to be operating at full capacity of 100 tons per day within a short time. The mill is at present treating 60 tons of ore per day, all of which comes from the oxidized zone above the 220-ft. level. On the Wonder-

ful claim a shaft has been sunk to the 100-ft. level and 250 ft. of cross-cutting driven.——The Consolidated Arizona Smelting Co. is measuring its ore-reserve. The smelter is being enlarged and when completed will have a capacity of 2,500,000 lb. of copper per month.——The 11 patented claims of the Yeager Canyon Copper Co. have been purchased by the Shannon Copper Co., for a consideration that is said to be $75,000.——The Locey Pabst Gold Mines Co. has resumed operations after a 60 days shut-down, awaiting electric equipment. It is announced that there is sufficient tonnage now developed to keep a 100-ton mill, which is to be erected at once, in operation.

Prescott, January 19.

YUMA COUNTY

(Special Correspondence.)—The greater Ajo Copper Co., which owns 68 claims in the Palomas district, has been purchased by a New York syndicate.——At a depth of 70 ft., in the inclined shaft of the Vindicator lease in the Salome-Wendon district, two feet of high-grade copper sulphide, running 25 to 35% copper and $10 gold, has been opened. Two carloads of ore have been shipped from this shaft.——The lessees on the Bullard property are shipping high-grade copper glance. ——The Black Reef has opened some good sulphide ore on the 300-ft. level. The drilling rig for testing the property of the Arizona Standard Copper Co. is now on the ground and drilling will commence immediately.

Yuma, January 18.

CALIFORNIA

BUTTE COUNTY

(Special Correspondence.)—High-grade ore has been uncovered near the bottom of the shaft of the Bumble Bee mine, in Morris ravine, and development is being conducted to determine its extent. The shaft is 400 ft. deep and development of the mine has been steadily proceeding since B. T. Hickman and Charles C. Vaughn acquired control. It is planned to operate the nearby Josephine property shortly. Both mines are near the Banner group.——Richard Phillips and New York associates have resumed work on the Banner group. The Banner is being placed in shape for extensive work, and the Amoskey mine has been unwatered and is undergoing repairs. Good ore was exposed in the Banner mine last summer, and sufficient capital is stated to be available for development at greater depth.

Oroville, January 27.

KERN COUNTY

(Special Correspondence.)—Work in the south face of the main cut at the Yellow Aster has uncovered ore buried by the great slide of 1914, and the old mill is again in operation, pending the completion of the new plant. The old mill has been idle about ten weeks owing to lack of profitable ore. In the new plant, which will have double the capacity of the old mill, the coarse product will be eliminated by screening and the fine ore, containing practically all the gold, will be fed directly to the stamps. The company is contemplating mining its huge bodies of low-grade ore by steam shovels, or a cableway excavator, and may discard the stamp-mill in favor of a set of ball-mills. The management is stripping the main deposit, but is hampered by lack of labor and high cost of materials.——Tungsten mining is claiming considerable attention in this field, and numerous properties are being prospected. The sharp decline of tungsten prices a year ago checked development of many promising deposits, but the outlook is favorable for an active summer.

Randsburg, January 26.

MARIPOSA COUNTY

(Special Correspondence.)—The Ruth Pierce mill is running full time; 35 men are employed. Considerable trouble with high-graders has been experienced this summer; $4000 in high-grade ore has been taken from caches made by Hungarian workmen.——The Mount Gaines property is being cleaned up and made ready for a force of men. A 100-hp. electric hoist is being installed.——The Mariposa grant dam has been restored to normal condition at Bagby, and the ore from the Queen Specimen is being milled at the Bagby plant. It is understood that the payment due this month has not been made and that the grant has reverted to the Mariposa Commercial Company. ——The Clearing House property is working full time, and the mill is running when conditions permit. The water in the Merced river has never been so low as it is now. This necessitates some shut-downs. The Mountain King is preparing to sink 600 ft. from the 1400-ft. level. The mill is running full time. The White Oak mine has installed electric equipment, and has completed the new shaft-work. A pole-line to connect the mine with the Kittridge plant of the San Joaquin Power Corp. is being put in. The work at the Castenetto mine is progressing slowly.

The White Gulch Mining Co., operating the Virginia mine, had considerable trouble with water on the 700-ft. level. A new large station pump is keeping the level clear. Until this fall the property has had considerable trouble getting sufficient water for operations. Conditions now are just the reverse. The Grey Eagle bond has expired and there is some litigation in prospect on the property. The Champion mine has added an electric equipment. The power company has expended a considerable sum taking the power from White's gulch to Coulterville and to the Champion mine.

A great deal of prospecting is going on throughout the county. It has been hampered, however, by lack of water. New prospects in Devils gulch and Sherlock gulch and in the Hite's Cove district on the East Belt are being made ready for operation. Labor, of a sort, is plentiful.

Bagby, January 20.

SAN BERNARDINO COUNTY

(Special Correspondence.)—The Tom Reed Gold Mines Co. and Clipper Mountain Gold Mines Co. have joined forces in driving a cross-cut from the 300-ft. level of the Clipper Mountain mine, Gold Reef district, to intersect the orebody. Powerful pumps have been installed, a large force of men set at work, and within three weeks R. B. Kepner, the manager, expects to intersect the foot-wall of the vein. On surface the vein is 40 ft. wide and assays $4 in gold. Both companies originally planned to sink their respective shafts to a depth of 500 ft., but at 300 ft. a heavy flow of water seriously hampered work.——Arrangements have been made for vigorous development of the Black Hawk gold property, 36 miles east of Victorville. The orebody is 30 ft. wide and assays $4. The mine was first worked in 1887 and a 10-stamp mill later erected, but the low-grade ore failed to yield profits. It is now controlled by the Merger Mines Co. of New York.

San Bernardino, January 27.

SHASTA COUNTY

(Special Correspondence.)—The Mammoth Copper Co., which recently took a bond on the Keystone mine midway between the Stowell and Balaklala mines, has struck a fine body of copper ore at the bottom of the 260-ft. shaft.——A two-stamp mill has been erected at the Yankee John mine, four miles west of Redding. It will be started up about February 1. T. E. Graff is superintendent of the mine and mill.

Redding, January 21.

(Special Correspondence.)—The Mammoth Copper Co. has transferred all its property at Kennett and vicinity to the parent corporation, the United States Smelting, Refining & Mining Co. The Mammoth company has ceased to exist; the purchasing branch of the smelting company is known as the United States Stores Company.

Redding, January 25.

COLORADO

DENVER COUNTY

A number of well-known Denver and Colorado business men have been carrying on investigations as to the possibilities of the Colorado shale fields as a source of oil supply. These investigations have extended over a period of some two years, and have been so satisfactory that the investigators have organized the American Mineral Oil Co., which is headed by H. M. Roeschlaub and backed by a board of directors of well-known business men. The company has acquired some 1400 acres of shale lands, and has under consideration a contract for the erection of a plant.

MINERAL COUNTY

(Special Correspondence.)—The Creede Quintette property at Sunnyside, which is being operated under lease by A. M. Collins, is rapidly developing into a bonanza. Shipments amounting to about 600 tons per month of 100-oz. silver ore are being made and the owners of adjoining property are threatening to start an apex suit. The success of the Quintette has stimulated interest in other properties in the Sunnyside section and considerable prospecting is being done.——The Creede Exploration Co., which holds a lease on most of the Amethyst vein below the level of the Nelson tunnel, has unwatered the Berkshire shaft on the Amethyst property and is driving both ways. A good grade of milling ore has been struck in the north drift. The Commodore shaft is being unwatered also and as soon as this is completed drifts will be run from it. This company also holds a lease on the Solomon property on East Willow creek and is sinking several winzes, one of which is reported to have struck high-grade galena.——Lessees are making small shipments from the Bachelor, Commodore, and Last Chance-Del Monte properties on the Amethyst vein.——A small amount of milling-ore is being extracted from the Happy Thought by the Creede United Co. and treated in the Humphreys mill.——Some small shipments have been made from the Holy Moses by lessees.——Shipments of fluorspar from the Wagon Wheel Gap mine amount to 2000 tons per month.

Creede, January 20.

SAN JUAN COUNTY

(Special Correspondence.)—For the first time in many years the mines that made Red Mountain famous, the Yankee Girl, Genessee-Vanderbilt, and other properties, now under lease to the Red Mountain Mines Co., are being operated during the winter. The winter work consists chiefly in getting the mines into shape to make a large production when the railroad starts running next spring.——Louis Schafer and associates are erecting an electric hoist on the St. Paul, near Red Mountain, which they have under lease.——John H. Slattery is successfully mining, under leases, the Highland Mary, Gold King, North Star on Sultan, and Detroit Colorado properties. He is also manager of the S. D. & G. Leasing Co. which operates a number of small leases.——The Copper King mine has been leased with a five-year bond.——The Coming Wonder on Anvil mountain is now being operated by a syndicate of local men who have bought the lease from Jackson & Anderson. Ore is being extracted from the old adit, while a new one is being driven at a lower level. The property is equipped with a tram that makes shipments all the year round possible. Edward Johnson is superintendent.——The Zuni mine on Anvil mountain has been leased to Jackson & Anderson who expect to start work soon. This was one of the early-day shippers of the district, but there has been no work done on it for several years.——The Champion property on Sultan mountain is being prospected with a diamond-drill for possible parallel veins.——The Lackawanna, on which operations were suspended a few weeks ago, will be started again. The tram to the railroad will be completed and the milling ore shipped by rail to the Little Dora mill for treatment.——The Peerless San Juan is working a small force in the mine. Delay in receiving machinery has prevented the completion of the repairs to the mill.——The changes in the Hamlet mill have been completed and work has been re-started.——The Durango smelter is adding additional roasting capacity to take care of the increased tonnage it is receiving from this and neighboring districts.——The Sunnyside Mines Co. is making fair progress with the construction of the crusher plant at the mine and the 500-ton flotation plant at Eureka.

Silverton, January 20.

TELLER COUNTY

(Special Correspondence.)—The report of Kenneth Mackenzie, president and general manager for the Acacia Gold Mining Co., shows a balance on January 1 of $17,608, a gain for the year of $3103 in addition to payment for sinking the shaft from the 100 to the 1450-ft. level and other development work and improvements to mine plant. The receipts for last year totalled $28,053 and expenditures $24,249.——The executive committee of the Cripple Creek Deep Drainage & Tunnel Co. has under consideration an increase of the working force to two shifts, both in the heading and Cresson cross-cut. The heading of the Roosevelt tunnel is now east of the Rose Nicol shaft and near to western boundary line of the Portland Gold Mining Co. A vein recently cut on the Rose Nicol Gold ground has assayed as high as $16 per ton.——The Excelsior Mining, Milling & Electric Co. is cutting a station at 600 ft. in the Llewellyn shaft on the Longfellow, and when this is completed shipments will be moving from this Stratton estate property on the south-eastern slope of Bull hill.——The Stratton estate management has sold the dump at the Abe Lincoln mine in Poverty gulch to Pfeiffer, Murphy & Kimsey of Cripple Creek, who have contracted to move it. The ore will be shipped to the Independence mill of the Portland Gold Mining Co. near Victor; samples taken indicate an average value of $5 per ton.——Three sets of lessees are engaged on the Lee and Empire State dumps of the Isabella Mines Co., and shipments are leaving the Bull Hill loading station at the rate of three cars, or about 100 tons, per week. The ore is being treated at the mill of the Golden Cycle Mining & Reduction Co. at Colorado Springs and is returning from $8 to $13 per ton.——A special meeting of the stockholders of the Hondo Gold Mining & Milling Co. has been called for January 28, to act upon a proposition to dissolve the company. The Hondo company has been operating the properties of the Keystone Gold Mining Co. under bond and lease at a loss.——The Cripple Creek district will be represented at the annual meeting of the Colorado Metal Mining Association to be held in connection with the meeting of the Colorado Chapter of the American Mining Congress, at Denver, by Thomas B. Crow, H. L. Shepherd, L. G. Carlton, M. J. McCarthy, Charles Walker, W. E. Ryan, H. P. Nagel Jr., C. D. Guerney, and E. P. Arthur Jr. The opening session will be held on January 22 at the State house.

Cripple Creek, January 21.

IDAHO

SHOSHONE COUNTY

A corporation that probably will be known at the Sunshine Consolidated Mining Co. has been formed by representatives of the Sunshine Mining Co., Tuscumbia Mining Co., Parrot Mining Co., Toughnut Mining Co., and Idora Mining Co., as the result of a meeting of representatives held in the office of the Idora company on January 17. The Day family of Wallace, large operators in the Coeur d'Alene region, are identified with three of the corporations. E. G. Ellis of Missoula, Montana, is a director of the Sunshine, and Whaley brothers and Mays of Missoula are the principal owners of the Tuscumbia.

Dan L. McGrath is directing the development of some of the properties. James C. Broad and C. E. Mallette of Spokane are identified with the Idora. The promoters will furnish funds for the enterprise, which includes the advance of an adit from which all of the mines can be penetrated at more than twice the present depth. The agreement was made subject to ratification by the stockholders of the respective companies.

The Sunshine Mining Co., which now has a capital of 1,500,000 shares, is to increase its capital to 2,500,000 shares, and all stock held by its stockholders is to be turned back into the treasury of the company. The 2,500,000 shares are then to be divided in equal amounts to 350,000 shares each among the five companies mentioned, leaving 750,000 shares in the treasury of the Sunshine company. The promoters of the consolidation agree to take 80,000 shares of the stock allotted to the Idora company and pay $40,000, to be used to pay the present indebtedness of the company. This would leave 270,000 shares of the stock of the consolidated company to be divided among the present stockholders of the Idora company. The amount of stock of the Idora company outstanding is 1,200,000 shares, which would give each stockholder one share of the Consolidated stock for practically four and a half shares of his Idora stock. The five properties form a compact group of 25 or more claims on Beaver creek in the Coeur d'Alene region. Two veins, known as the Tuscumbia and the Idora, traverse the group on parallel lines at points about 300 ft. apart. It is proposed to advance an adit between the veins and crosscut from it into the several properties at a maximum depth of 1200 to 1300 ft. An adit that may be used for this purpose has been started. Ore has been exposed in all of the mines at depths ranging from 300 to 500 ft., so the greater corporation would have something tangible upon which to proceed in its development at depth.

The Hecla Mining Co. declared a dividend of 5c. per share, $50,000, on January 20, bringing the total disbursed to date to $6,955,000.——The Caledonia Mining Co. has declared its regular monthly dividend amounting to $78,150, payable on February 5. This brings the total disbursements to $2,991,641.——The 200-ton plant of the Spokane Metals Recovery Co., on Nine Mile creek, 3½ miles from Wallace, is nearly completed. The plant is situated below the Rex dump, and is in a position to receive mineral from the creek that flows from the Interstate-Callahan, Success, and Rex properties. The settling tank measures 30 by 30 by 8 ft. The equipment includes a flotation system and tables. The water of the creek and its mineral content will be conveyed to the plant by a flume 500 ft. long. C. L. Hewett, mining engineer, is president and manager of the company, M. H. Eggleston vice-president, David Holzman treasurer, and H. W. Ingalls assistant secretary. The production in this county, embracing the Coeur d'Alene region, was $51,717,573 in 1917, as compared with $44,311,304 in 1916. The figures for 1917 follow:

Lead lb.	380,950,000	$33,474,077
Zinc, lb.	93,100,000	8,127,630
Copper, lb.	1,423,600	386,497
Silver, oz.	11,875,000	9,647,369
Gold, oz.	4,100	82,000

These figures are based on the average price of the metals for the year.

MONTANA

LEWIS AND CLARK COUNTY

(Special Correspondence.)—The Helena mining district is more than usually active. New mines are being developed and old properties are being unwatered and prepared for active working. Among these is the Lee Mountain at Rimini. Two shafts are to be sunk below the lower adit-level. The power is to be acquired from the Valley Forge plant on the east side of Ten Mile creek. The Lee Mountain has produced a large tonnage in silver-lead ore. The Bullion King in the Park district, Broadwater county, has been taken over by new men and has been unwatered to the bottom of the old workings, which were down 180 ft. The shaft is to be sunk to the 250-ft. level. In Lump gulch the Liverpool mine has been bought and is to be immediately unwatered. The Amalgamated Silver Mines Co. is sinking the Free Coinage shaft No. 2 down to the 250-ft. station. The old shaft is 180 ft. deep and has been retimbered. The Mountain States silver-lead mine on Warm springs is also being unwatered to the 150-ft. level. The Cruse Developing Co., in Scratch Gravel hills, is stoping ore for shipment from the 640-ft. level east of the shaft. The Cruse Con. and Rock Rose management has decided to sink a shaft 1000 ft. on the Looby, Grass Valley district.

Helena, January 19.

SILVER BOW COUNTY

(Special Correspondence.)—The Davis-Daly Copper Co. has added an Ingersoll-Rand electrically-driven air-compressor, having a free-air capacity of 2800 cu. ft. per minute, to its equipment. The Colorado mine is sending 200 tons of high-grade ore per day to the East Butte smelter. The Hibernian is sending 100 tons of ore per day to the Washoe smelter.—— The Butte Bullwhacker Copper Co. has elected the following officers for the year: A. Frank, president; H. I. Wilson, vice-president; H. Frank, secretary; D. J. Fitzgerald, treasurer.—— The Barnes-King Development Co. declared a dividend of 10c. per share, $10,000, payable February 15, to stock of record January 25.——The December earnings were between $75,000 and $80,000. Development work is progressing on the Shannon property, and the orebodies are holding up well.

Butte, January 20.

NEVADA

CLARK COUNTY

(Special Correspondence.)—The Boss Gold Mining Co. has increased its quarterly dividend to three cents per share, the first disbursement under the new rate to be made February 10 to stockholders of record February 1. The company is shipping 200 tons of gold-silver-platinum ore per month to the Los Angeles plant of the Palau Metals Co. This product is stated to average nearly $200 per ton. A new contract is under consideration for disposal of the copper ore to better advantage. ——The Manganese Corporation is shipping steadily from extensive manganese deposits near Las Vegas, and late work has materially extended the ore-bearing area. The company is improving shipping facilities, preliminary to a heavier output. ——F. H. Hamilton and associates of Los Angeles have acquired control of several manganese claims and are preparing for extensive work. Eastern steel mills have arranged to take all the ore that can be produced.

Goodsprings, January 21.

HUMBOLDT COUNTY

(Special Correspondence.)—Inability of the Nevada Short Line railway to handle a steady output of ore continues to hamper production in the Rochester field. The Rochester Merger, Rochester United, Nenzel Crown Point, and other companies are ready to ship to the Mammoth smelter, at Kennett, California, but the railroad will not be in shape for some time to transport ore. Plans for rehabilitation of the line are under consideration.——Tungsten production is again claiming attention near Mill City. The Mill City Tungsten Co. is shipping steadily to the Toulon mill, and has 23 men employed. Good ore is being opened at several points under management of Thomas Sutton.——The Nevada Humboldt Co. is increasing its working-force and shipping steadily.——At the Olson group development of an excellent orebody is proceeding and shipments are going out. Several small operators are developing promising territory and expect to ship soon.

Four eight-horse and ten-horse teams are steadily employed in transporting ore to Mill City from the neighboring mines. The ore occurs as scheelite. The Humboldt Consolidated Co. is doing extensive work at the La Toscha mine, in Wright's canyon. The orebody has been tapped at a depth of 1345 ft. below the outcrop and shows a width of six feet of milling ore. Of this a 30-in. shoot is stated to assay 17 oz. silver and $10 gold per ton. The development consists of an adit, 3500 ft. long, and numerous drifts and cross-cuts. It is planned to erect a mill in the early summer.

Lovelock, January 19.

(Special Correspondence.)—An agreement has been entered into between the Nenzel Crown Point Mining Co. and the United States Smelting, Refining & Mining Co., whereby the latter company agrees to develop the Crown Point company's mine, build a suitable mill, and make such other improvements as may be required. The smelting company is to be reimbursed from the proceeds of the mine.

Rochester, January 25.

WASHOE COUNTY

(Special Correspondence.)—George Hiell, the lessee who recently made a rich strike on the old State Line mine on what is believed to be the extension of the No. 4 vein of the Nixon-Nevada, has done enough work on the vein to convince him that he has made a genuine find and he is now engaged in widening the adit and putting in a track. The last assays from the lowest workings show that the high-grade ore averages a little better than $200 per ton, while the lower-grade product will run $60.——At the Nixon-Nevada mine, work on the main cross-cut is proceeding steadily but it has not yet reached the big No. 4 vein which it will tap at a depth of over 800 ft. on its dip. For the last 100 ft. the ground has been heavily mineralized. Surface trenching is still under way and has developed good showings in six veins besides those that have been opened at depth by the main cross-cut.

Copperfield, January 19.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—An order has been placed by Socorro Mining & Milling Co. for a new double-drum electric hoist, with a capacity of 2200 ft. in depth. This will be the largest hoist in the district. The old hoist will be used during delivery.——Peterson and associates are developing the Iron Bar group. A cross-cut adit has been run in over 500 ft. and the owners expect to cut the contact within a month.——The Oaks Co. continues daily shipments from the various holdings. The ore recently cut in the Deep Down mine was opened during the week in the levels below.

Mogollon, January 22.

OKLAHOMA

OTTAWA COUNTY

The construction of the 300-ton concentrating plant of the Producers' Mining Co. will be started soon and pushed as much as possible to make up for lost time. The Producers' company some weeks ago purchased the lease on a 40-acre tract of the Mary Whitebird land, immediately north-east of Picher. One shaft is being sunk into ore on this tract. The principal value to the lease is contributed by the result of the test holes of which there were 20 that showed ore-faces extending from 45 to 70 ft. in thickness, and assaying from 6 to 30% lead and zinc. L. V. Hivick, of Oklahoma City, is president, George B. Rittenhouse is vice-president, T. R. H. Smith, also of Oklahoma City, is secretary-treasurer.

OREGON

JACKSON COUNTY

(Special Correspondence.)—L. H. Van Horn of Kirby and associates have taken a lease and bond for two years on the Copper King copper mine in the Blue Ledge district, with the stipulation that work must begin at the mine within 60 days. The mine property consists of eight claims, or 160 acres.——The machinery for the State 200-ton limestone-fertilizer plant at Gold Hill has arrived from the East. The 7000-ft. aerial tramway at the Greenback mine has been dismantled and shipped to equip the plant, which will be operated by electric power. Contracts call for the completion of the plant by April 1. The Rogue River Public Service Corporation, operators of power plants at Gold Hill and Grants Pass, which went into the hands of a receiver last June, has gone into involuntary bankruptcy, with liabilities of $650,000. Since the corporation's financial troubles last year most of its contracts have been taken over by the California-Oregon Power Co., with plants on Rogue and Klamath rivers.——Much progress is being made in the development and equipment of the cinnabar mines in the Meadows and Lake Creek districts, north of Gold Hill, with a view to a record production in the coming year.

Gold Hill, January 26.

JOSEPHINE COUNTY

(Special Correspondence.)—George S. Barton is opening a new chromite deposit on the Waldo Corporation property that is giving considerable promise. Mr. Barton will operate continuously through the winter.

Grants Pass, January 20.

SOUTH DAKOTA

LAWRENCE COUNTY

The new power-plant of the Homestake Mining Co. was completed on December 27 and, after a few hitches, successfully started on the first day of the year. The plant consists of two 1000-k.v.a. generators, each driven by two Pelton impulse turbines; two sets of three 666-k.v.a. Westinghouse transformers; and two Allis-Chalmers motor generators. The water is delivered at the nozzles under a static head of 547 ft. The work was started last April and consisted of the building of two concrete dams, laying of 27,000 ft. of redwood-stave pipe, the driving of 5044 ft. of tunnel, the building of several bridges and trestles to carry the pipe, and the erection of an electric transmission line. The work was designed by F. G. Baum of San Francisco and carried out by A. L. Wilcox. About 120 men were employed daily during construction.

WASHINGTON

STEVENS COUNTY

The United Copper Mining Co., operating at Chewelah, shipped 2 carloads of crude ore and 11 carloads of concentrate in December.

Ore in a body three feet wide containing 52 oz. of silver and 15% copper has been followed 30 ft. north on the 1250-ft. level. Other levels have contained equally rich ore, but not in a body of this width. If the body proves to have a considerable length it will make a big addition to the value of the mine. The same shoot has been followed south of the shaft, but it is not so rich. Concentrate of a higher metallic content has been produced in the last 30 days of operation. This results from improvements to the mill. The silver content is 31.8 oz. per ton of concentrate, and the copper runs 16%, a gain of 6 oz. of silver and 6% copper. The plant is saving 92% of the copper, as compared with 83 to 84% before the installation, and 93% of the silver, as compared with 85 to 86%.

The Consolidated Mining & Smelting Co. has intimated its readiness to accept United Copper ore at the Trail smelter, beginning February 15. The previous destination of the product has been Tacoma. The number of men employed at the properties has been increased to 115. The outlook of the company for the current year is good. The entire property,

including both the United Copper and the Copper King, is being sampled and surveyed. The inquiry goes into all details of milling. The results of the survey and the sampling will be compiled for the benefit of the stockholders.

STEVENS COUNTY

The new tramway of the Northwest Magnesite Co. was placed in operation on January 22, and the first rock from the quarries, 5½ miles distant, was received at the calcining plant, a mile south of Chewelah, during the day. The tramway has a capacity of 30 tons per hour, but this can be doubled by the addition of buckets. The Riblet Tramway Co. is installing transportation equipment for the Valley Magnesite Co. and the American Minerals Production Co. The Valley tramway will connect the quarries with the kilns, half a mile apart, and the American tramway will connect the quarries and kilns of the Red Marble quarry with the Spokane Valley & Northern railway, a mile away.

MEXICO

SONORA

(Special Correspondence.)—E. P. Spalding, of New York, and associates have secured a lease on the semi-anthracite coal land of Carlos F. Johnson, which is about three miles north-east of Ortiz, and about 60 miles from Guaymas. The coal land covers an area of about 32 square miles. The development consists of three shafts, the deepest of which is 400 ft., and a number of prospect holes and also a bore hole at El Salto, which has a depth of 460 ft. and which cut through three seams of coal having a total indicated width of 35 feet. Extensive exploration by means of diamond-drills is now contemplated and arrangements will be made for the Southern Pacific of Mexico to build a 30-mile road to tap the field. The lease is said to be for 99 years with option to purchase at the end of five years for $3,000,000. The contract calls for periodic payments to the owners who will also receive 15c. per ton of coal mined.

Guaymas, January 20.

CANADA

MANITOBA

A discovery of rich gold ore has been made just off the trail leading from Big Clearwater lake to the Gold Pan mine by E. E. Kain. Mr. Kain saw some of the Gold Pan ore in Minneapolis some time ago, and he came to the district with two other prospectors. The new find has been the result of his search. A number of samples were sent to Bisbee, Arizona, and have given returns running as high as $400 per ton, while the average of the batch ran over $60 per ton.

KOREA

The Seoul Mining Co., operating the Suan Concession in Whang Hai Province, reports a total recovery of $207,050 for December.

Military Appointments

E. R. Lidvall is in the 27th Engineers at Camp Meade, Maryland.

H. C. Dudley is with the 36th Regiment of Engineers at Camp Grant.

W. H. Coleman has enlisted in the 23rd Engineers and is at Laurel, Maryland.

William A. Argall, who is in the 148th Regiment, U. S. Field Artillery, is on his way to France.

Joseph Hyde Pratt is now Lieutenant-Colonel of the 105th Engineers, at Camp Sevier, South Carolina.

Andrew Newberry has been promoted to Captain in the 4th Regiment of Engineers, now at Camp Greene.

P. R. Hines has been commissioned Lieutenant in the 318th Engineers, at Vancouver barracks, Washington.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Thos. B. Stearns is at Washington.

F. L. Bosqui is at the Fairmont hotel.

W. W. Mein has returned to New York.

Horace F. Lunt, of Colorado Springs, is in Arizona.

William B. Fisher is now residing at Santa Barbara.

C. T. Nicolson has returned from the Malay States to Milwaukee.

Thomas Neilson has returned from the Philippine Islands to Los Angeles.

W. J. Watson is again manager of the Ladysmith smelter, British Columbia.

Theodore Chapin, of the U. S. Geological Survey, is at Silver Lake, California.

Whitman Symmes has returned from Washington, and is now at Virginia City.

G. L. Sheldon passed through San Francisco on his return from Riverside to Ely.

Robert C. Sticht has returned to his post as manager of the Mt. Lyell in Tasmania.

Walter Douglas passed through San Francisco on his way from New York to Bisbee.

D'Arcy Weatherbe passed through San Francisco on his return from Russia to London.

Ross B. Hoffmann is due in San Francisco from Siberia about the middle of February.

Henry E. Wood passed through San Francisco on his way from Denver to La Jolla, California.

Edwin W. Mills has changed his headquarters as consulting mining engineer to Yokohoma, Japan.

H. H. Hassan has closed the Great Falls mine, in Maryland, and has opened an office in New York.

George J. Young has become assistant editor-in-chief to the 'Engineering & Mining Journal' at New York.

H. DeC. Richards is now consulting engineer to the Central Eureka Mining Co. at Sutter Creek, California.

X. B. Starnes has accepted a position in the geological department of the Phelps-Dodge Corporation at Morenci, Arizona.

Charles H. White, recently professor at Harvard, was an expert witness in the White Caps v. Morning Glory case at Tonopah.

James E. McGuire, recently manager of the Witwatersand Deep mine at Johannesburg, has returned to Grass Valley, California.

Dennis M. Hines has resigned as mine foreman to the Cinco Minas company, in Jalisco, Mexico, to join the 27th Engineers at Camp Meade.

Charles W. Cook, Professor of Economic Geology in the University of Michigan, passed through San Francisco on his way to Los Angeles.

Ellsworth H. Shriver, Lieutenant in the Regiment of Engineers, has been transferred from the 23rd to the 27th Regiment, and is at Camp Meade, Maryland.

Thomas Varley, superintendent at the Pacific Northwest Experiment Station of the U. S. Bureau of Mines, is in California, investigating the metallurgy of quicksilver.

Fred S. Norcross Jr., superintendent of mines for the Canada Copper Corporation, has obtained a commission as Captain in the U. S. R. Engineers and is at Camp Lee.

E. H. Clausen has received a commission as Captain in the Engineer's Section, O. R. C. He is now reconstructing the 20-stamp cyanide mill of the Colorado Mining Co. at Aroroy, Masbate, P. I.

THE METAL MARKET



METAL PRICES

San Francisco, January 29

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.95
Antimony, cents per pound	17.50
Antimony (wholesale), cents per pound	14.25
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67½
Pig-lead, cents per pound	7.00— 8.00
Platinum, soft and hard metal, respectively, per ounce	108— 116
Quicksilver, per flask of 75 lb	$125
Spelter, cents per pound	10.50
Zinc-dust, cents per pound	20.00

ORE PRICES

San Francisco, January 29

Antimony, 45% metal, per unit	$1.00
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.70— 0.85
Magnesite, crude, per ton	$8.00—10.00

There is little demand for either calcined or crude magnesite.

Manganese: The Eastern manganese market continues fairly strong with $1 per unit Mn quoted on the basis of 48% material.

Tungsten, 60% WO_3, per unit	26.00

Tungsten ore remains firm.

Molybdenite, per unit MoS_2	$40.00—45.00

EASTERN METAL MARKET

(By wire from New York)

January 29.—Copper is quiet and unchanged at 23.50c. all week. Lead is inactive and firm at 7c. all week. Zinc is dull and steady at 7.87c. all week. Platinum is unchanged at $108 for soft metal and $116 for hard.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending			
Jan.	23	87.87	Dec.	18	85.38
"	24	87.37	"	25	86.42
"	25	87.37	Jan.	1	86.62
"	26	87.12	"	8	88.66
"	27 Sunday		"	15	90.04
"	28 Holiday		"	22	89.29
"	29	87.12	"	29	87.35

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	48.85	56.76	75.14	July	47.52	63.06	78.92
Feb.	48.45	56.74	77.54	Aug.	47.11	66.07	85.40
Mch.	50.61	57.89	74.13	Sept.	48.77	68.51	100.73
Apr.	50.25	64.37	72.51	Oct.	49.40	67.86	87.38
May	49.87	74.27	74.61	Nov.	51.88	71.60	85.97
June	49.03	65.04	76.44	Dec.	55.34	75.70	85.97

Samuel Montagu & Co. states that a royal proclamation was issued on January 21 providing for the establishment of a branch of the Royal Mint at or near Bombay. The gold coins issued therefrom are to be current and possess the same legal tender that they would have done had they been coined and issued in England. The proclamation is to become effective next June.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending			
Jan.	23	23.50	Dec.	18	23.50
"	24	23.50	"	25	23.50
"	25	23.50	Jan.	1	23.50
"	26	23.50	"	8	23.50
"	27 Sunday		"	15	23.50
"	28 Holiday		"	22	23.50
"	29	23.50	"	29	23.50

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	13.60	24.30	29.53	July	19.09	25.66	29.67
Feb.	14.38	26.62	34.57	Aug.	17.27	27.03	27.42
Mch.	14.80	26.65	36.00	Sept.	17.69	28.28	25.11
Apr.	16.64	28.02	33.16	Oct.	17.90	28.50	23.50
May	18.71	29.02	31.69	Nov.	18.88	31.95	23.50
June	19.75	27.47	32.57	Dec.	20.67	32.89	23.50

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending			
Jan.	23	7.87	Dec.	18	7.75
"	24	7.87	"	25	7.75
"	25	7.87	Jan.	1	7.87
"	26	7.87	"	8	7.87
"	27 Sunday		"	15	7.87
"	28 Holiday		"	22	7.87
"	29	7.87	"	29	7.87

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	6.30	18.21	9.75	July	20.54	9.00	8.98
Feb.	9.05	19.99	10.45	Aug.	14.17	9.03	8.58
Mch.	8.40	18.40	10.78	Sept.	14.14	9.18	8.33
Apr.	9.78	18.62	10.20	Oct.	14.05	9.92	8.32
May	17.03	16.01	9.41	Nov.	17.20	11.81	7.76
June	22.20	12.85	9.63	Dec.	16.75	11.26	7.84

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending			
Jan.	23	7.00	Dec.	18	6.50
"	24	7.00	"	25	6.46
"	25	7.00	Jan.	1	6.50
"	26	7.00	"	8	6.65
"	27 Sunday		"	15	6.75
"	28 Holiday		"	22	6.98
"	29	7.00	"	29	7.00

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	3.73	5.95	7.64	July	5.59	6.40	10.93
Feb.	3.83	6.23	9.01	Aug.	4.62	6.28	10.75
Mch.	4.04	7.26	10.07	Sept.	4.62	6.86	9.07
Apr.	4.21	7.70	9.38	Oct.	4.62	7.02	6.97
May	4.24	7.38	10.29	Nov.	5.15	7.07	6.38
June	5.75	6.88	11.74	Dec.	5.34	7.55	6.49

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending

Date					
Jan.	1	130.00	Jan.	15	130.00
"	8	130.00	"	22	125.00
			"	29	125.00

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	51.90	222.00	81.00	July	95.00	81.20	102.00
Feb.	60.00	295.00	126.25	Aug.	93.75	74.50	115.00
Mch.	78.00	219.00	113.75	Sept.	91.00	75.00	112.00
Apr.	77.50	141.60	114.50	Oct.	92.90	78.20	102.00
May	75.00	90.00	104.00	Nov.	101.50	79.50	102.50
June	90.00	74.70	85.50	Dec.	123.00	80.00	117.42

TIN

Prices in New York, in cents per pound.

Monthly averages

	1915	1916	1917		1915	1916	1917
Jan.	34.40	41.76	44.10	July	37.38	38.37	62.80
Feb.	37.23	42.60	51.47	Aug.	34.37	38.88	62.53
Mch.	48.76	50.50	54.27	Sept.	33.12	36.66	61.54
Apr.	48.25	51.49	55.63	Oct.	33.00	41.10	62.24
May	39.28	49.10	63.21	Nov.	39.50	44.12	74.18
June	40.26	42.07	61.93	Dec.	38.71	42.55	85.00

Tin remains a market without quotation. All prices are absolutely nominal and it is almost impossible to quote any price whatsoever. Banca ton for shipment January-February from the Far East has been done at 67½ cents.

Charles Hardy says: Legislation is proposed for Government control of the mining and mineral industry, especially in regard to such ores as are produced in small deposits such as chromite, manganese, tungsten, molybdenite, graphite, and others. The outcome of this bill is expected by the trade, and meanwhile the buyers of some of the minerals are hesitating and buying only for their immediate wants.

The tungsten market has been quite steady during the past week. Considerable business has been done in spot lots and most of the off-grade ore which has been on the New York market for some time has been disposed of. The prices range from $24.50 for 65% down to $20 for impure ore, with ore under 60% selling below that figure. Scheelite has been a little easier on account of ore being offered from California as well as from South America; the principal buyers of scheelite have for the moment withdrawn from the market.

The Canadian government has lifted the embargo on molybdenite and recently offers for molybdenite as well as ferro-molybdenum have been received in this country. The reason for the lifting of the embargo is said to be due to the fact that the Canadian producers complain that at the prices fixed by the Government production was handicapped and by selling at the higher prices ruling in the United States, their production would be stimulated to everybody's advantage. Here the arrivals have been larger than for some time past and the market ranges from $2.15 to $2.20 per lb. for the 85% concentrate.

The January price for manganese remains at $1.20 delivered at furnace for high-grade material. Arrivals from Cuba have been small on account of the rainy season in those markets.

Chrome ore is scarce and people are asking as high as $1.50 per unit for material over 45%. One carload is now offered at that figure, but the sale has not been consummated.

Eastern Metal Market

New York, January 23.

There is no activity in any of the markets, and this has been the striking feature for weeks. Such Government buying as is being done is conducted very quietly in most cases.

Copper prices are not to be changed for four months. The market is quiet.

Tin for spot delivery is still scarce with prices nominal at about 86c., New York.

Lead is at a dead stop, with prices nominal.

Zinc is still inactive at unchanged prices.

Antimony is in poor demand.

In the steel trade the curtailment, due to the five-day shutdown, is estimated to have been from 10 to 15% from the already restricted rate of recent weeks. The steel trade as a whole felt the order for fuel conservation less than other industries because so large a part of the output is now for the Government or its Allies. In the East snow storms and more cold waves have added to the blockade and have neutralized to some extent the possible good to be accomplished by the five-day idleness in general. It is the severest winter in the Eastern States in many years.

COPPER

The copper industry has been generally exempt from the industrial paralysis in the East due to the Fuel Administrator's five-day shut-down. The industry pertains mostly to the West, or is exempt because of necessary continuous operation. In the New York district two large refineries were affected differently, due to varying interpretations of the local fuel administrators. The large refinery of the Nichols Copper Co. on Long Island closed, but that of the American Smelting & Refining Co. in New Jersey operated, having been exempted by the local administrator. The shut-down of the Long Island refinery, however, was for one day only, exemption having been later granted. The usual rumors are prevalent as to the necessity for a higher price for copper, probably 25c., but there is not much ground for belief that any change will be made. Sales are being made of large and small lots at the Government prices of 23.50c. and 24.67½c. per lb., as regulated by the Copper Producers' Committee. There has been some disinclination to buy ahead in the hope that the price will be reduced. There is a rumor that some copper has been sold in Canada by Americans at higher levels than the fixed prices, but this is not confirmed. It has been ruled by the Copper Producers' Committee that out of town dealers may add 5% and the cost of the freight to the Government price of 23.50c. when selling less than carload lots. Newspaper advice from Washington states that on the recommendation of the War Industries Board President Wilson extended, on January 22, the price of 23.50c. per lb. for copper until June 1.

TIN

There has been no change in the market in the last week. Consumers dropped out when the fuel conservation order was announced, and remained out of the market to see what its effect would be. There was no effect noticeable. Buyers are extremely cautious. Dealers are having much trouble solving problems connected with the rules laid down by Government regulation, and there is much confusion and delay. Permits for shipments from England are still held up for the principal grades. Some off-grade metal is allowed to come, for which there is a good demand from small consumers. These are specially hard hit, and it is the belief of some that there will be no relief until July. Offers of metal for shipment from the East have not been plentiful in the last week. The arrivals to January 22, inclusive, have been 965 tons, with 5300 tons reported afloat. The London tin market is higher again. The quotation yesterday, January 22, for spot straits was £302 per ton, against £299 10s. a week ago.

LEAD

The transportation problem with its many difficulties has completely tied up the lead market which has come to a decided stop. It is nominal at 7c., New York, or 6.85c., St. Louis, in the outside market, with 6.75c. the New York quotation of the leading interest. The situation at this end is tight, with the market firm. Metal is not being received in plenty, and stocks are diminishing. Some predict an 8c. price before many weeks. Offerings are not large, some producers stating that they do not have the metal to sell, while others say that it is useless to offer it, for it cannot be shipped. Many consumers are in a similar frame of mind. They refrain from purchasing because they not only have large quantities on the way but also because they feel there is little chance of getting it if they buy it.

ZINC

The principal topic in the zinc trade, outside of the general stoppage of industry for fuel conservation, has been the meeting last week in Washington between the Zinc Committee and the War Industries Board. It was held primarily to discuss a fixed price for grade A zinc, but no decision has been announced yet. It is not believed that price Western and other grades will be regulated, but that they will be left to their regular course unless a runaway market should develop. If a price on grade A is fixed, it is generally expected here that it will be at 12.50 to 13.50c. per lb. The Garfield order to shut down industry, together with the 'coalless Monday,' has rather upset nominal conditions here in the last four or five days, but the market is nearing its normal state again. Inquiry is reported as fairly good, especially for prime Western, but one representative of a large producer states that this grade is rather scarce, more so than would be expected in view of the large stocks of zinc in general reported as of the year end. Sales are being made at 7⅞ to 7¾c., St. Louis, for January-February delivery, but there is not much doing beyond March. A continual contraction in production is reported. Many producers can operate only at a bare profit at present levels. Quotations today are 7⅞ to 8c., New York, for prime Western for early delivery with slight premiums asked for future positions.

ANTIMONY

Chinese and Japanese grades are unchanged at 14 to 14.25c., New York, duty paid, for spot and early delivery, but the market is firmer, due to reported fairly large purchases by the Government again this week, details of which are withheld.

ALUMINUM

The market for No. 1 virgin metal, 98 to 99% pure, is unchanged at 36 to 38c. per pound, New York, for spot and early delivery. No agreement is said to have been reached yet as to a fixed price for the metal.

ORES

Tungsten: There are Japanese agents in New York offering tungsten ore mined in Japan. Prices are unchanged at $24 to $26 per unit in 60% concentrates, and the market is steady with a fair business reported, especially in spot lots. Ferrotungsten has been offered at $2.35 per lb. of contained tungsten, which is probably about the market.

Molybdenum and Antimony: Quotations range at $2.15 to $2.20 per lb. of MoS_2 in regular concentrates, with offerings more liberal because of the lifting of the Canadian embargo on shipments to this country. There is nothing to report in the antimony ore market in this district.



INFORMATION FURNISHED BY MANUFACTURERS

HEAT-TREATED GEARING

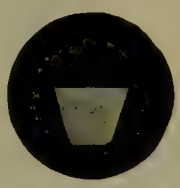
By W. H. PHILLIPS

Steel gears may be divided as to material and structure into two general classes, namely, alloy-steels and carbon-steels. Alloys of nickel, chrome-vanadium, and similar elements with the steel, produce a very strong tough gear which, however, on account of its high cost, is practicable for only a few special uses. The great field of gearing is served by carbon-steel products with entire satisfaction.

Since it is possible by heat treatment to increase the life of carbon-steel gears by as much as 200 to 400%, with an increase in cost of but 25 to 50%, these processes have received much attention. There are now three general classes of treatment: (1) oil treatment, (2) case-hardening, and (3) special treatment.

There are applications where the service is so light that the resultant long life and low maintenance-cost do not justify a high-grade product. There are other services where the gear must transmit a uniformly high torque without sudden jars or dynamic blows, in which case it is a question of wear alone, requiring such hardness of the surface as is found in the case-hardened product. There are other applications where the load to be transmitted is uniformly low but subject to occasional shocks. This last-named condition requires a gear with only medium hardness but with high ductility, such as the first-class or oil-treated gear. There are installations, and these are in the majority, where the service imposes both the heavy duty with its resultant wear as well as shocks with the liability of breakage. It is for such service that the third class or special grades have been developed. By analyzing the conditions and selecting the proper grade, it will be possible to obtain the best results. With the ever increasing knowledge of steel and its possibilities of its heat-treatment, which are being accumulated from year to year, the first two grades were improved gradually until now they have been perfected as far as possible and the metallurgist for some time has been looking to other fields for a grade that would include the good qualities of both while yet supplying what they lacked and, if possible, reducing the cost of the heat-treatment. At stated before, the alloy-steel had to be eliminated on account of its cost, and the only course left was to develop a treatment for carbon-steel that would afford the required results. Several of these so-called special grades were introduced, one of the more notable being the 'BP' grade manufactured by the R. D. Nuttall Co. of Pittsburgh.

It was found that, by slight changes in chemical structure, a combination could be obtained, which, when subjected to a special treatment, produces physical properties peculiarly adapted to gearing. The hardness at the surface of the steel is from three to four times that of untreated steel, and grades off slightly toward the centre of the tooth until it is from two and one-half to three times as hard as untreated steel. This reduction in hardness is in a straight-line ratio, and each fibre of the steel, from the surface to the centre, or the neutral axis of the tooth, which may be slightly to one side of the geometric centre, will be stressed in proportion to its ability to carry the load. So that, when the tooth receives a blow or a shock every fibre is carrying its share of the load. The ductility of this steel is comparatively high, and is in inverse ratio to the strength. The metal is homogeneous, there being no line of demarkation between any two fibres. While the surface of the tooth is hard, it is at the same time tough and will not check nor spall. It is often advisable to treat only the pinion of a combination, it being the weaker and hardest-worked member. A pinion so treated, due to the character of the hardness developed, is not liable to cause excessive wear on the meshing untreated gear. It can



SECTION OF BP GEAR, SHOWING FINE GRAIN AND UNIFORM STRUCTURE



SECTION OF ORDINARY UNTREATED GEAR

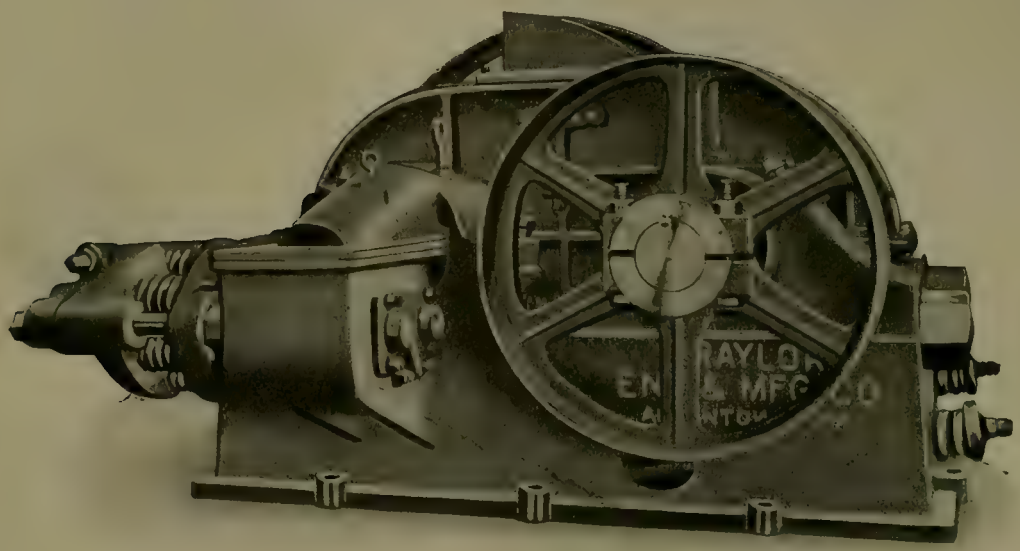
be readily seen that a gear of this type, which is of moderate price, will have a pronounced tendency to overcome breakage, and at the same time will give a high resistance to wear. It should at least triple the life of untreated gearing, and eliminate the cost of damage and delays caused by gear breakage.

If by increasing the cost of gearing from 25 to 50%, a gear is produced that will more than triple the life of the untreated steel-gear and at the same time eliminate breakage with its consequent damage, there can be no doubt as to its economy. A few of the advantages to be derived by such a step are: (1) lower ultimate cost of the gearing, (2) reduction of time-loss, (3) reduction of labor-cost in maintenance, (4) reliability. For example, the untreated gear costs $20 and runs one year. The treated gear costs $30 and runs three years. This would show a saving of $30 on the initial cost. If it requires two hours to make a replacement, it would require six hours to replace the $20 gear three times, and but two hours to replace the $30 gear; this gives four hours saved in labor, and four hours saved in the output from the machine. The hazard of breakage, with its consequences, is an unknown factor, but may be serious in some services. The wide application of the heat-treated gear not only in railway and automobile operation, but also in many other branches of industry, such as steel mills, foundries, glass plants, and mines, has been so successful that it is not a question of heat-treated *v.* untreated gearing, but rather the selection of the proper grade of treated gearing for the service to be performed. In conclusion it might be said, with many industries of the country over capacity, the necessity for reliabilty of the machine parts was never before so necessary nor the consequences of a break-down so costly. A careful study of gear in industrial plants and mines should be made at this time, and changes that will insure increased reliability should be acted upon at once.

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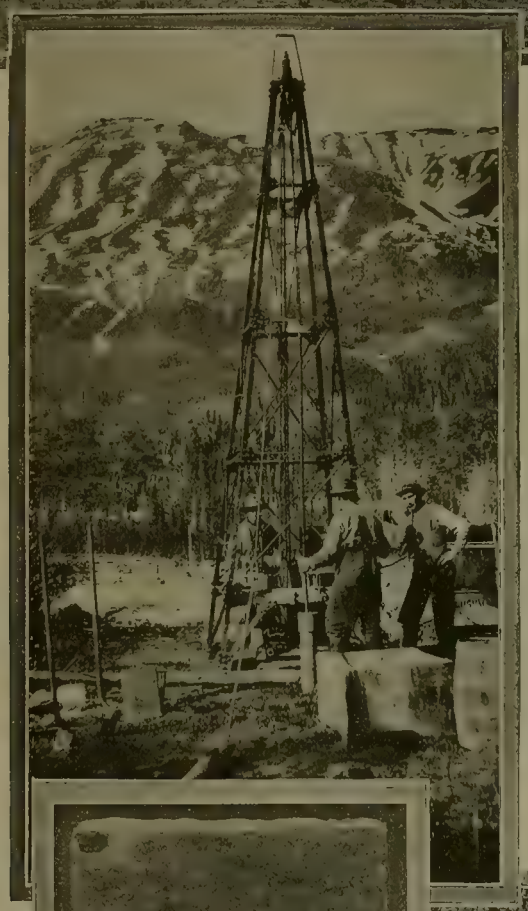
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EDITORIAL

OUR New York market letter calls attention to the fact that shortage of coal for the railroads in Brazil has led that Government to announce a total suspension of shipments of manganese ore for a period of 60 days.

FOR the information of the public the War Trade Board has issued a bulletin giving the rules and regulations adopted for the control of foreign commerce. It includes the President's proclamations prohibiting the exportation of certain articles, the Trading with the Enemy Act in full, legal forms for making application for export licenses, and a mass of detail that should be known by all persons engaged in foreign business. A copy of the bulletin may be obtained from the Division of Information of the War Trade Board at Washington.

INTERNATIONAL rates of exchange are becoming interesting even to the man in the street or the nearest equivalent in complacent ignorance. We draw attention to the fact that current exchange-bureau rates at Hongkong are $5 in American paper for $4 American gold coin, a premium of 25% for the metal over its equivalent in a monetary medium equally current at par in the United States or over corresponding bank exchange. Is this the small cloud on the horizon? Does it signify a reactionary appreciation of gold after the orgy of paper-credits on which the nations are now spending their financial vigor?

COLONEL W. B. THOMPSON, whom we know not in his military capacity but as a resourceful and honorable operator of mines, is reported to have given a million dollars to the Bolsheviki to aid them in spreading their propaganda among the Austrians and Germans. He is credited with having aided these incendiaries in setting the Teuton coat-tails on fire. Colonel Thompson may know what he is about, but he looks to us like a man hiring some small boys to set fire to his neighbor's hay-field regardless of the danger of the wind blowing sparks on his own crop. This anti-social anarchistic radicalism of the Bolsheviki is not a thing to play with; before the War ends we may find it difficult to prevent spontaneous political combustion of a similar kind in our own demesne. Returning Americans dwell upon the lofty ideals and sterling qualities of the Russians; we know the Russians also; just now they appear to be going down a steep place into the sea, led by as irresponsible an element as ever sat in places of power. Trotzky and his crew would come to terms with the Enemy tomorrow, condone the violation of Belgium, ignore the devastation of Serbia, and forget the frightfulness that has horrified the world, in order to make Russia safe from further invasion. All this talk of self-determination by a people that refuses to fight is pitiful nonsense. Those that are either too proud or too timid to fight organized hell will have to lick the boots of the Prussian.

SOME of the people have wondered what is the matter with Argentina. One conspicuous fact about Argentina is that she has not cast in her lot with the nations that are fighting Germany. Perhaps President Irigoyen is after the halo that signifies "He kept us out of war." We do not insist upon the validity of the argument, yet an odor of sauerkraut these days is suspicious, and when we observe the list of authors of the bulletins issued by the Argentine 'Dirección General de Minas' and find a succession of names such as Beder, Stappenbeck, Kühn, Stieglitz, Windhausen, and Groeber, we wonder whether the matter is that the Government is too hyphenated. To be perfectly fair we must admit that considerable criticism has been aroused in this country over the large Teutonic flavor of the personnel of some of the departments at Washington, especially where those departments have shown a tendency to inaction or obstruction.

KNOWLEDGE of flotation is beginning to filter through the daily press and the public is being treated to sundry sophomoric efforts at technical description. In one of our local organs of misinformation we read that "the ore is ground up with a little oil," and "when the ore is crushed and the pulp mixed with water and properly stirred up by machinery, air is injected to make the resultant soup, so to speak, get frothy. The froth is skimmed off as it reaches the top, and as it liquifies or is evaporated, the metal is automatically precipitated." This might be worse. "The amount of oil," we are told, "averages about two pounds to the ton of ore," from which we suspect the source of the reporter's information. "Whisky or vinegar, phenol, cresol, pine-oil,

eucalyptus oil—almost anything that will make a froth can be used successfully." This should please a prohibitionist and might refer to a politician.

BAINBRIDGE COLBY, a member of the American War Commission, on his return from Europe, exclaims: "The sumptuousness of life here is terrible. Think of the congestion of automobiles on Fifth avenue, and they have not motors enough at the front in France. We have made no sacrifices. So far we have only been a sentimental factor in the War." Much of this is true. The mobs that fill the hotels at night, dining lavishly and dancing to rag-time music, provoke the contempt of any thoughtful man. Out of our hundred millions, 3 or 4% are doing all they can, in service or in money, but the bulk of the population is still trying to 'forget it,' to do 'business as usual,' to proceed on the even tenor of its way, despite the irritation of taxes and subscriptions, as if the destiny of the world—and of America—were not in the balance.

A SERIOUS controversy between the United States and Spain would be a most regrettable event. We can understand that the Germans would be delighted to cause a rupture in the pleasant relations that have existed between the two countries during recent years, and it must be borne in mind that the Germans are even more active in Spain than in America. The rabid socialists of Catalonia are working hand in glove with the Teutons, and as the bulk of Spanish manufacturing is in that border province it has been possible to hinder in many ways the shipment of supplies to our army in France. The story that King Alfonso inclines toward his remote kindred in Austria, however, would seem to be of Teutonic inspiration. The security of the Spanish monarchy rests at this time upon neutrality, and a constant effort has been made to keep in power a neutral ministry. The struggle in the Cortes between the 'Germanophiles' and the 'Germanophobes' has been so violent, however, that ministries have risen and fallen like ninepins in a bowling-alley, in consequence of which the King has been forced to carry the appeal to the country. We believe that the popular sentiment strongly favors the Allies, and if international complications can be averted for a few weeks until the elections are over, it is likely that the new chamber will be found to represent opinion favorable to the maintenance of a genuine neutrality. Our relations with Spain will exert a powerful influence upon the attitude of the South American countries, so that the case is one that demands the exercise of careful and wise diplomacy.

IT seems reasonable to suggest that the interminable litigation over the flotation patents might be settled by a technical commission, on the precedent created by the Selby Smelter Commission, which ended the wrangle between the Selby Smelting & Lead Company and the recalcitrant farmers of Solano county. In that case a stipulation was made by the attorneys of the plaintiff and the defendant setting forth that, owing to the expense and delay to be incurred in determining the merits of the suit by the Court, it seemed preferable to place the matter in the hands of a technical commission, which should ascertain the facts and "fix and determine the conditions under which the defendant's plant may operate." Both litigants bound themselves to abide by the findings of the Commission. As originally constituted this Commission consisted of Messrs. Joseph A. Holmes, Director of the U. S. Bureau of Mines, William F. Snow and Ralph A. Gould. Dr. Snow was unable to serve, his place being taken by Mr. E. C. Franklin of Stanford University. Another precedent has been set by the fortunate mediation of the Government between the competitive manufacturers of aeroplanes, resulting in concessions that gave compensative advantages to the litigants, while the imperative needs of the country in its preparation for war were met intelligently. It seems to us that a commission headed by a broad-minded technologist to be nominated from the U. S. Bureau of Mines by the Director of that bureau, Mr. Van H. Manning, together with a nominee from each of the belligerent camps, would constitute a commission able to settle the controversy and terminate a litigation that is checking the wheels of metallurgical progress.

WHEN Mr. Charles S. Palmer was telling his story of Prussian blue, which will be found on another page of this issue, he omitted the reminder that Prussian blue is a virulent poison. It even originated in Berlin, where so much else has been engendered to envenom millions of innocent men throughout the world. The fact that the discovery of the ferric ferro-cyanide was the result of accident may well be credited; most of the chemicals of commerce were found by blundering upon them in the time-honored pragmatic fashion so dear to the heart of the late Professor James. Ammonia was first obtained and sent over the caravan routes of Asia Minor, to serve the needs of man, from a particularly filthy temple of Jupiter, where the peculiar qualities of that chemical were supposed to have been discovered in a priestly effort to clean house. The reaction in the blast-furnace, whereby cyanogen is formed and gives rise to the well-known cycle, in the course of which active reduction of iron is accomplished, is reputed to have been realized first through the discovery of a workman that a white incrustation accumulating on the outer brick wall of a furnace in Pennsylvania was useful for cleansing his hands. His spouse being a washerwoman, he took some of the salt home to her, and the remarkable properties of the alkaline cyanide led her to move her tubs near to the source of supply at the iron-furnace. Then the chemists took note of it, and traced out the interesting and important cyanogen-factor in the chemistry of iron smelting. We hasten to add that no mortality occurred among the patrons of this venturesome laundress who was content to know that she had found a strong solvent for grease without considering its perilous nature.

Alaska Juneau

Among the mining disappointments of 1917 none is so regrettable as that of the Alaska Juneau enterprise. It is the more noteworthy because it is associated, by reason of propinquity, and in other ways, with the Alaska Gastineau fiasco and the drowning of the Treadwell group of mines. Three years ago the district around Juneau, on the mainland and on Douglas island, was made conspicuous by the publication of estimates and expectations of large-scale low-grade gold mining that appeared destined to make a new and extremely interesting chapter in the history of American enterprise. That chapter is half-written and it is in the red ink of debit. The account, however, is not closed and the final balance may yet retrieve the first failure. The Treadwell group is in a bad way, for even if the deeper ground should be reached and mined by means of a level from the Ready Bullion shaft, the prospect of a return to prosperity is dim. The Alaska Gold Mines, controlling the Alaska Gastineau, has been proved the victim of incorrect inferences from sampling so fatal as to render nugatory the success of a new departure in milling. The Juneau is the immediate subject of discussion. For many years before 1915 this mine was treated as one of the Alaska Treadwell group, although separated by the strait called Gastineau channel, because friendly stockholding interests were represented by interlocking managements. Mr. F. W. Bradley was president and consulting engineer of the Treadwell group, and president of the Juneau company, with Mr. Robert A. Kinzie as resident manager for both mines. The Juneau was owned by a private company that included Wernher, Beit & Co., the Exploration Company, Smith & Perkins, and the Mein estate. Up to 1915 this company had paid $55,000 in dividends. From 1897 to 1900 inclusive an output of 72,321 tons was treated, after careful sorting, in the 30-stamp mill. The yield averaged $4.10 in free gold, no concentrate being made. During the subsequent nine years, from 1901 to 1909, an output of 181,436 tons was treated in the same mill for an average yield of $1.45 per ton, also in free gold. The lower return was due to a change of method, careful sorting giving way to the selection of the best blocks of ground, supplemented by rough sorting. Between 1903 and 1905 two adits, 400 and 500 ft. respectively below the open-cuts from which the previous output had come, were driven through the lode. Slices from the sides of these workings were treated in a 5-stamp mill. This sampling indicated 343 feet yielding 90 cents in free gold in the upper adit and 570 feet of an equal gold content in the lower adit, a part of which, 173 feet long, showed $1.22 per ton in free gold. In August 1910 Mr. Bradley suggested that $500,000 be spent in driving an adit 5700 feet long and in raising 900 feet to the upper workings, together with the erection of a 100-stamp mill, a power plant, and such other equipment as might be required to test the possibility of exploiting this big low-grade deposit on an adequate scale. Moreover, he offered to complete 5000 feet of the proposed adit for 50 shares of the company's stock per linear foot, that is, 250,000 shares for the whole 5000 feet of adit. In 1903 the Juneau company's capital had been increased from 500,000 to 750,000 shares, and the 250,000 shares happened to be intact. Upon the completion of the adit he was to equip the mine as planned, to a capacity of 23,000 tons per month, and in return therefor he was to receive 250,000 shares more, the capital of the company being increased that much. Thus he would become owner of half the enterprise, which, together with his other holdings, would give him the control. On December 19, 1910, an agreement embodying these terms was consummated through Mr. H. C. Perkins and accepted by all the stockholders. Thereupon Mr. Bradley allotted one-third of his interest in the contract to Mr. Ogden Mills, controlling shareholder in the Treadwell mines, and another third to the San Francisco Exploration Company, a partnership consisting of Messrs. J. H. Mackenzie, M. L. Requa, and Mr. Bradley. The allotment of these participations, we believe, was prompted by motives of loyalty and friendship, not with the idea of spreading the risk. Later the stock held by Wernher, Beit & Co. was purchased by Mr. W. H. Crocker.

Where cut by the lower adit the lode showed an average assay-value of $2 per ton; whereupon Mr. Bradley estimated the cost of operation at 80 cents per ton, and stated that he expected a yield of $1.45 in gold. The accuracy of this forecast was to be determined by the operation of a pilot-mill then nearing completion. Mr. Bradley's expectation was based on his experience at Treadwell, together with such mining and milling as he had supervised at the Juneau mine itself. He expected that, whereas sorting of $4\frac{1}{2}:1$ had yielded an average of $4.10 during four years, and whereas selection of ground and rough sorting had yielded an average of $1.45 during nine years, it would be practicable to obtain an average yield of $2.70 by sorting 3:1 henceforth when mining in winter underground. In 1912 Mr. D. C. Jackling started the Alaska Gold Mines enterprise, to exploit the old Perseverance mine and adjoining ground, the idea being to send the ore to the mill as stoped, without sorting, and thereby obtain a $1.50 recovery at a cost of 75 cents per ton. This proved illusory, the yield in 1916 averaging 93 cents at a cost of 71 cents per ton. Returning to the Juneau enterprise: Mr. Bradley strongly opposed a public flotation, intending to conduct it as a private company, arguing that if it were good enough for himself and his friends, he would carry it to fruition, and if it were not good enough he would not shift the loss to the public. Mr. Mills and Mr. Mackenzie were in accord with him from the first, but Mr. Requa thought it advisable to make a public issue and thereby, presumably, render his holding, and that of others, more liquid. Later, Mr. Mackenzie, impressed by Mr. Jackling's successful flotation of the Alaska Gastineau and by the propaganda of Hayden, Stone & Co., who an-

nounced the discovery, during development, of such patches of rich ore as would increase the average yield of the Gastineau mine beyond the original estimate, agreed to Mr. Requa's proposal. Under pressure of the wishes of his two immediate associates, Mr. Bradley also consented to a public flotation. It is fair to add that he had taken note of the fact that the Juneau pilot-mill was then receiving a feed of over $1.50 per ton on run-of-mine and of over $3 on sorted ore; and he also had been impressed by the statements of new ore discoveries by the Gastineau mine management. Therefore he consented to a public flotation of the Juneau in March 1915. Shortly thereafter the capitalization of the Alaska Juneau Gold Mining Company was increased to $15,000,000 in shares of $10 each. At the time of this flotation a report by Messrs. Bradley and Mackenzie was circulated. In the report they stated that there was available 80 to 100 million tons of ore "that should yield a net profit of from 70 cents to $1 per ton," and that the company should "be able to earn at least $1,400,000 per annum." A block of 400,000 shares at $10 per share was offered to the public with this report. The issue was underwritten and sold successfully at par by a syndicate headed by Mr. Bernard M. Baruch. He took pains to emphasize the conservative character of the technical estimates, so that the shares rose to $15, at which price considerable unloading occurred. A pilot-mill of 50 stamps, to sample the lode on a large scale, went to work in 1914. During 1914, 1915, and 1916 the record of production was as follows:

		Gold assay-value	Yield		
	Tons	per ton	Gold	Concentrate	Tailing
1914	60,026	$1.43	$0.91	$0.25	$0.27
1915	179,892	1.48	0.693	0.486	0.296
1916	180,113	0.91	0.039	0.612	0.26

A concentrate of lead and another of iron were produced, but the above figures do not include the lead and silver for which the smelter paid. In the report for 1916 Mr. Bradley stated that up to that date, including the early milling in Silver Bow basin, the mine had yielded 742,220 tons having an average assay-value of $1.93 per ton for gold only, and that the large-scale milling of the future should be done on an ore containing $1 per ton in gold, silver, lead, and zinc. The cost was estimated not to exceed 50 cents per ton, having in view a capacity of 10,000 to 12,000 tons per day in the new mill. This may be compared with the expectation, expressed in 1913, of $1.45 in yield and 80 cents in cost. Evidently the expectations on which the Juneau enterprise was started had begun to suffer a discounting, but the margin of profit had survived and the tonnage of ore assured was so great as to indicate a winning by no means unsatisfactory. Meanwhile the question of building a large mill was under advisement. The 50-stamp pilot-mill was treating the ore at a cost of 29 cents per ton, which was excellent. The question arose whether to add to this plant or to build an entirely new mill of different design. Mr. Bradley was inclined to be cautious, the technical opinion at his disposal being divided as to the kind of crushing and pulverizing machines best adapted to the Juneau ore. Unfortunately, early in 1915 he became ill, and in May he had to go to Honolulu to recuperate. During his absence Mr. Requa issued a circular, dated May 4, 1915, repeating that the mine contained 80 to 100 million tons of ore "on which a profit of from 70 cents to one dollar per ton will be realized." He suggested the probability that 240 to 300 million tons might become available. He referred to the Treadwell mines as having a lode of undiminished value and size down to 2000 feet below sea-level and predicted the continuity of the Juneau orebody to "an indefinite depth." He announced that Mr. George O. Bradley, who had been consulting engineer to the Utah Copper company, was to design and supervise the erection of a mill having a capacity of 8000 tons per day. Ultimately a daily capacity of 20,000 tons was not an unreasonable hope, he concluded. Shortly after this optimistic announcement the directors, in Mr. Bradley's absence, gave full authority to Mr. Mackenzie, as consulting engineer, with instructions to do whatever was necessary to expedite the preliminary mine-work, and to design and erect a mill of 8000 tons capacity. Two years later, on March 31, 1917, the new mill was ready to start. At the end of May, Mr. Mackenzie relinquished his duty as consulting engineer. A series of difficulties developed, the lining of the ball-mills proved defective, the passing of the ore from the gyratory crushers direct to ball-mills of an untried type failed to produce the desired pulverization, the capacity of the plant was only 1200 tons per day in May and 3274 in December, the highest being 3833 tons per day in November, or considerably less than half that expected. The cost of milling during the last four months of 1917 was 40 cents per ton, the total cost 70 cents per ton, and the yield 75% from a feed assaying 82 cents in gold per ton, so that a loss of 8 cents per ton was recorded, the lead and silver value being absorbed by freight and treatment charges on the concentrate. The average gold-assay value of the mill-feed for the year 1917 was 90 cents. The operating loss incurred since the mill started has been $144,940. At present an indebtedness of $1,100,000 exists. The mill is acknowledged to be a failure as it now stands; not only has it failed in crushing capacity but the operating cost is higher and the recovery of gold lower than was estimated.

Another lesson taught by bitter experience is that an exaggerated idea of the width of the ore along the main cross-cut was caused by the drag of the fault, which crosses the lode obliquely. In this locality an excessive admixture of gouge and broken country-rock from the fault lowers the grade of the mill-feed below the economic limit. Hence the disappointing returns, made worse by the high cost of milling, itself due to defects in the equipment. Experiments are in progress with a view to an automatic rejection of the bigger lumps of waste; a re-arrangement of the grizzlies between the jaw-breakers and the gyratory crushers is expected to

exclude the coarse waste and so enable the gyratories to deliver a finer feed to the Bonnot ball-mills. The hope still persists that the duty of these can be raised to 80% of the maximum anticipation, giving the mill a capacity of 9000 tons per day. Preparatory work is now proceeding underground with the intention of using the caving method along the strike of the lode, instead of along the fault, where, as already explained, an excessive admixture of waste has diluted the grade of the ore unduly. In these new stopes, 400 feet west of the fault, and just beyond the ground opened up in the last three years, recent sampling shows $1.90 per ton. Between the fault and the Ebner boundary, where a cross-cut exposes over 100 feet of lode assaying better than $2 per ton, there is a stretch of ground 2000 feet long, so that on that side and above the adit there is estimated to be 70 million tons of ore. In 1915 the results and estimates of the Gastineau, the boundary of which is 3500 feet east of the fault, were considered the more important, but later evidence suggests that the Juneau has the better prospects in the opposite direction. Allowing for dilution by waste coming from the hanging wall, Mr. Bradley expects to obtain a mill-feed of $1.25, or a recovery of $1 per ton. He is still confident of bringing the enterprise to success, and has assumed the whole burden of responsibility with a courage and a resourcefulness that deserve the highest respect.

Mexican Mining Law

Mexico is reported to be considering a greatly needed reform in her mining decrees. Under the mining law of the Republic the annual rental is a fixed amount for each pertenencia of 100 metres square. As a means of wedging the Americans loose from much valuable property, without correspondingly reducing the Federal receipts, the so-called tax, or rental, by decree was made cumulative, that is, it was augmented in proportion to the increase in the number of claims held by an individual or by a single corporation. In consequence, thousands of mining claims have been surrendered by Americans, while the burdens have accumulated upon those who still cling to their holdings in that inhospitable country. It must not be assumed that the proposed change in the basis of rental on mining-leaseholds is to be made in deference to American interests or through the diplomatic persuasion of our ambassador. It merely implies that oppressive taxation has squeezed out as many American mine-owners as, by that means, can be made to let their property go, and that meanwhile the cost of holding mines under the tax-decrees has grown too onerous both for the Mexicans themselves and for their German patrons, who have been most active in acquiring mining property all over the Republic during the last two years. We can understand that the German-owned Compañia de Minerales y Metales, which is the Mexican subsidiary of the American Metal Company, through its representative, Mr. Henry Bruère, who is at the same time financial advisor to the Carranza government, would naturally have suggested that the time had come for a change in policy. This company has been busily gathering up the properties relinquished by other aliens in Mexico. Most of these properties have passed through the fingers of Mexicans on their way to the new owners, so that they may feel the fleeting material satisfaction of an Ishmael while the Teuton makes off with the birthright. The 'M. & M.' company has bought mines in every portion of Mexico, from the far south to the Rio Grande; it is the largest industrial organization in the Republic today; it has opened extensive coal mines, has acquired the old Madero smelter at Torreon, as well as the one at Saltillo, and has constructed still another smelter at Monterrey. It owns and controls the largest equipment of rolling-stock now being operated over the Mexican National Railways. The early enterprise and courageous initiative of American investors in Mexico have thus been turned to account by the wily Germans who have not only supplanted us in the ownership of vast metal resources in that country, but have thereby acquired a respect in the eyes of the people that serves to intensify their contempt for the American. These things have been rendered possible, first of all, by the disregard of our Department of State for the rights of our citizens abroad, an attitude that no administration will ever again assume after we have finished our present war for the security of Americans and of democracy; and it has been assisted by the promises and ready cash so freely offered by the representatives of the Hohenzollerns in Mexico City. Mexico is filled with Germans abundantly supplied with money, and it is not difficult for them to persuade the multitude that the Kaiser will win, and that he will then reward his good Mexican friends. We must remember that the facts regarding our preparations for war and the achievements of our Allies do not readily reach the masses in Mexico; the barrier of language and the further obstacle created by the spirit of dominance and disdain assumed by our own citizens in recent years have predisposed the Mexicans to welcome a 'gringo' of another race that is at least in unison with him in hating the American and in scoffing at him. Meanwhile, the mines are passing into the hands of the most exacting alien owner he could have selected, and all that he has to show for them is the pittance extracted by the political favorites for serving as transfer-agent.

It is worth while again to point out to the Mexican people, as we did at length several years ago, that their mining law as it stood then, and as it stands today, is a rich man's law. The Mexicans have been told that they possess a poor-man's bill of rights in the Steffens-Carranza constitution, adopted at Queretaro, but they should note that the new constitution did not extinguish the power of the Government to distribute concessions, which are tools of corruption for the politicians, while they give to monopoly a throttling grip on the economic life of the people. Neither did the constitution open the

mineral wealth of the country equally to rich and poor, and it is the poor who generally discover the new mineral deposits. The cost of 'denouncing' or locating a mining claim represents more money than passes through an ordinary peon's or vaquero's pocket in a year; to hold the claim after getting title he must pay the rental every four months, otherwise it instantly becomes forfeit. No legal means are provided for cheaply retaining possession until he has had opportunity to develop; he must not ship a pound of the ore to meet his payments; he must wait for that until his leasehold title has been issued. To obtain legal possession of a mining claim he first must pay to the Government a sum that would rank a poor Mexican as a capitalist in his mountain pueblo. If the American system of locating and holding mining claims were adopted in Mexico there would suddenly come to light thousands of valuable deposits, now known only to the wanderers in the hills, and kept concealed because they cannot afford to acquire them under the law and develop them, while those who have the money with which to pay the requisite fees will not give the discoverer more than the price of a goat or a bottle of tequila to be shown the vein. In working out the principles of agrarian reform we would suggest to the Mexican public that they include in their programme a sound revision of the mining law, so that the plain man may be able to avail himself of the natural resources of his country to lift himself to independence.

Food Control

Interest in the conservation of food is growing, but not fast enough; neither is it sufficiently general, despite the entreaties of the Food Administration. A large portion of the community remains callous to the urgency of the work being done to regulate our own consumption in order to ensure the supply needed for the less favored of our Allies. We note that Mr. Hoover is seeking further powers from Congress. They are wanted in order to compel the careless and unthinking to share the sacrifice—so small a portion compared with the supreme sacrifice faced by our fighting men. Our own observation leads us to conclude that in many homes flaunting the Food Administration card there is as yet only an incomplete compliance even with the limited restrictions of the wheatless meal per day, the wheatless day and the meatless day each week, and but small regard for the request to decrease the use of butter, sugar, and so forth. 'Hooverizing' is treated a little too much as if it were a novel game, instead of being a deeply serious necessity. It is difficult for unimaginative persons to realize that if they halve their consumption of wheat, and if others like them do so also, the resultant saving among a people of 100 millions will be so enormous as to feed 50 millions in Europe. Apropos of sugar, our people eat about $250,000,000 worth of candy per annum. The growth of the habit is due in part to the spread of prohibition, the sugar of the candy helping to satisfy the natural craving for a stimulant; but most of the candy-eating is a mere luxury, often dyspeptic. It seems to us that the manufacturers of candy might be diverted to the making of food-stuffs and chemicals of a more useful kind, considering that sugar is so much in demand. However little the American home may be doing to conserve the food required for export, it is certain that the hotels and clubs are more negligent. Even the least observant can note the waste of bread and of butter. A superfluity of bread is served; and as for butter, the average waiter seems to consider it a sacred duty to add a fresh pat before the preceding is half-gone, even at the close of a meal. The clubs ought to set a good example. They do not. For instance, the serving of fish 'a la Meunière', which entails an excess of melted butter, should be prohibited. Many people seem to be ignorant of the fact that wheat, fat, and sugar are consumed in pies and pastry. The homely doughnut requires lard. Saratoga chips and fried potatoes waste good fat. Eat boiled or baked potatoes. Do not imagine that the eating of macaroni and spaghetti helps the Italians. The fact is that this matter of food conservation is regarded by many grown men as an eccentricity instead of being recognized as a real necessity. It is time to place a taboo on banquets and luxurious eating of every kind, if only to make the unthinking realize that big events are afoot and that millions are starving in consequence of a conflict that will settle the destiny of this and of other countries. As a sign of stupidity we may mention the throwing of rice at the close of a recent wedding at a municipal office. A few pounds of rice do not amount to much, but to throw away good food at a time like this is the act of a fool. So was the burning of tallow candles behind the Red Cross sign during the recent big drive. Indeed, we fear that the only way to make everybody pay due regard to food conservation is to control the manufacture of commodities and to penalize the wastage of them. It may seem undemocratic, but war cannot be conducted on democratic lines, and the sooner we realize the fact the stronger will be our determination to make an end of wars. Of course, if warfare is to become a chronic failing among so-called civilized peoples, it will be absurd to perpetuate our present forms of government, because they are inefficient as military organizations. Democracy cannot survive in a militant world. We intend to make the world safe for democracy, do we not? Then let us, who are staying at home while others are going forward to the front, show a little unselfishness in this matter of food, at least. We are informed that the Food Administration considers the voluntary honor ration per person per week to be

Meat and meat products	2 lb. 0 oz.
Butter for table use	7 "
Fat for cooking	7 "
Wheat flour for cooking	7 "
Bread or mixed cereals	3 lb. 8 "
Sugar (not including sugar in preserves)	12 "

Take this schedule as your guide and ask the housekeeper how nearly you are living in accord with it.



TAILING EXCAVATOR, GENERAL VIEW OF NEW CORNELIA PLANT, AND CEMENTATION VATS

Copper-Leaching at Ajo

By COURTENAY DE KALB

In outline, the leaching of oxidized copper ores with sulphuric acid, and the subsequent deposition of the metal by electrolysis is delightfully simple; in practice, it is full of intricate details and not a few perplexities. When the exploration of the Ajo deposit was begun no one could have foreseen that the success of the enterprise was destined to depend upon the solution of the problem of treating economically 12,000,000 tons of low-grade carbonate ore. An overburden of lean oxidized ground covering sulphides is a common occurrence, and its removal involves an expenditure that must be included in the total cost of mining and treatment of the ore. At Ajo a new condition was presented. Development soon showed that a metallurgical difficulty barred the way to success. The carbonate was not a mere overburden to be thrown to one side for future consideration, as was done, for example, at the Utah Copper, because here the oxidized ore constituted the bulk of the available deposit. Neglecting this, the mine would be of inferior magnitude. Recognition of the fact came early in the course of development. Drilling was commenced in the autumn of 1911, and by July 1912 the company had started Stuart Croasdale upon an investigation to find a metallurgic method suited to the ore. His results are given in a paper published by the American Institute of Mining Engineers (Trans. Vol. XLIX, p. 610). Although his experiments took into account the possibilities of chloridizing, and also of precipitating copper from sulphate solutions electrolytically, the important fact was established that the copper could be leached with dilute sulphuric acid, and precipitated on iron; that the solutions, including their burden of iron sulphates, could be thrown to waste; and yet the process would afford a profitable result when copper was selling at 12c. per pound. In an illuminating review[1] of the known methods of dissolving and precipitating copper, with special reference to the conditions at Ajo, L. D. Ricketts called this the "brutal method"; nevertheless, it answered definitely an urgent question; it showed that the work of development that had been done up to that time might be continued in full confidence that the simplest and least refined course of treatment would enable the mine to be operated at a profit.

The preliminary tests determined also that fine grinding was not essential. Mr. Croasdale obtained a recovery of 80% of the original copper content by crushing to a maximum size of No. 3 mesh, that is, about 8 mm. This was an exceedingly important point, since fine grinding is expensive. He employed a lixiviant containing 5% sulphuric acid, and this has now been reduced to 3%, so that an original consumption of 3½ to 4 lb. of acid per pound of copper recovered has been lowered to 2½ to 3 lb. Such economy is possible partly by reason of the regeneration of acid in the electrolytic vats. Further work showed that it was desirable to reduce the ore to about ¼ in. size.

The earlier studies were made at Douglas, to which point 400 tons of ore were shipped to Ajo. Part of the investigation was conducted by Mr. Croasdale, assisted by H. A. Tobelmann and James A. Potter, while, later, chloridizing and sulphatizing roasts were made by Utley Wedge in the plant of the Pennsylvania Salt Co. at Philadelphia. In order that no confusion may exist it is well to state at this point that the process as finally adopted does not involve any form of roasting. The ore is treated with no further preparation than crushing. Dr. Ricketts has expressed his belief in the great future of chlorine compounds in the hydro-metallurgy of copper, but he considered that sulphuric acid offered fewer difficulties as a solvent for the type of ore to be treated at Ajo. Both Mr. Croasdale and Mr. Wedge tested the possibilities of roasting with salt, but the idea was abandoned on the ground that the advantages to be gained were not commensurate with the extra cost. Mr. Wedge had proposed that both the oxidized and the sul-

[1]Trans. A. I. M. E., Vol. LII, p. 747 et 529.

phide ores might be mined at the same time and in the same proportions as they existed in the deposit; in that case the resulting mixture would have contained sufficient sulphur for a sulphating roast, and the experiments proved that this line of treatment would yield a high recovery, but the operation requires careful attention in order to maintain the proper temperatures. Mr. Wedge points out[2] that CuS, acting as the molecule Cu_2S_2, decomposes in roasting to $Cu_2S + S$. The liberated S oxidizes to SO_2 above 350° C., and the Cu_2S, at furnace-temperatures below 500°, reacts as follows:

$$2Cu_2S + 5O_2 = 2CuO + 2CuSO_4$$

At higher temperatures, however, the reaction is

$$Cu_2S + O_2 = 2CuO + S$$

The several copper-sulphide minerals behave differently at the same temperatures, but the tendency of all copper sulphides is to form an oxide of some degree at all furnace-temperatures. In order to produce the water-soluble sulphate it is necessary to overcome the tendency to the formation of oxide, and it must be noted that iron sulphide associated with the copper sulphide in the ore is of material aid in accomplishing this purpose in roasting. Mr. Wedge states: "At furnace-temperatures below 600° C. there is formed some basic iron sulphate, which, at temperatures above 530° C., roasts to Fe_2O_3 and SO_3, and the SO_3 gas may combine with the CuO to form $CuSO_4$, which is practically stable at temperatures below 650° C.; or the CuO may react directly with the $Fe_2(SO_4)_3$ according to the reaction

$$3CuO + Fe_2(SO_4)_3 = Fe_2O_3 + 3CuSO_4"$$

Furthermore, he recalls the catalytic effect of Fe_2O_3 between the temperatures of 500° and 750° C., causing the further oxidation of SO_2 to SO_3, which, at that heat, will unite with CuO to form $CuSO_4$. When ores containing 1.86% copper, to which 6% of pyrite analyzing 47% S had been added, were roasted in a 5-hearth Wedge mechanical furnace, 95.2% of the copper became soluble in water. Using the solution on successive charges until it contained 15% $CuSO_4$ the tailing contained only 0.08% copper. This is a good example of the possibilities of sulphatizing. About the same time, or a little later, Frederick P. Laist made similar tests at Anaconda, where he also demonstrated that a high recovery could be secured by calcining a mixture of sulphide and oxidized copper ore and tailing. Here again the control of temperature was the vital point; if the temperature became too high a large amount of the copper was rendered insoluble either in water or in acid. The problem at Ajo rested more distinctly upon economy in precipitation, for it was easy to leach 80% of the copper from the oxidized ores by merely circulating a weak solution of sulphuric acid through a vat of coarsely crushed ore, and the cost of mining would be greatly reduced by taking the upper carbonate ore first instead of complicating the operation by parallel extraction of the oxidized and sulphide ores.

[2]'The Sulphatizing-Roasting of Copper Ores,' Utley Wedge, Trans. A. I. M. E., Vol. XLIV, p. 818.

After having ascertained that the "brutal method," based on the transportation of Alabama pig-iron to Ajo for precipitation, was economically feasible, experiments were undertaken to produce sponge-iron in the Wedge furnace, starting with high-grade pyritic ore from the mines at Bisbee. This ore contains above 45% each of sulphur and iron, and about 2% copper. In carrying out this plan, the gases from the roasting-furnaces would have been utilized for making sulphuric acid. Some of the iron was reduced in these experiments, but the results were only partly satisfactory, and this was confirmed by work of like character by Mr. Laist at Anaconda. Electrolytic deposition of the copper from the leach-liquors promptly disclosed two serious difficulties. One was the production of an excess of acid salts that dissolved copper from the cathode; the other was the fouling of the solution by an accumulation of salts of iron and aluminum. Interesting and technically important experiments were conducted in an effort to overcome this trouble. One set of tests, made by F. L. Antisell, at the Raritan Copper Works, had in view the precipitation of the copper in the presence of large amounts of those salts. He used nearly the same leaching cycle as that finally adopted at Ajo, and he employed SO_2 on a large scale for reducing the ferric sulphate so as to avoid resolution of copper during electrolysis. His method depended on a patented anode consisting in a wooden case packed with coke, and having an elongated rectangular graphite energizer in the centre. The solution passed upward over the cathode and downward through the 'basket' anode, issuing through an opening in the bottom. At first difficulty was experienced in obtaining complete absorption of the SO_2, but even with this the results were good in some respects. Nearly two pounds of copper was precipitated per kilowatt hour, but the anode proved cumbersome and poorly adapted to large-scale operation. Parallel with this F. A. Pope and A. W. Hahn were engaged to test a method for the removal of the iron and most of the other impurities before sending the solution to the electrolytic vats. It involved a counter-current leach, so controlled as to admit of drawing two grades of solution from the system, one of which was relatively much higher in iron than the other. To the high-iron solution was added a calculated amount of finely ground roasted ore containing copper oxide. This removed from the solution about 90% of the iron and 80% of the alumina. The process offered many advantages, and was eminently successful at the experimental plant at Ajo, where 329 tons was treated in this manner, but it would have necessitated the complication of the large works with fine-crushing machinery, agitators, and filter-presses, and it would have involved the purchase of high-grade sulphide ore or concentrate. Meanwhile, the leaching tests, under the close supervision of Capt. Greenway, had developed an interesting fact. When neutral solution from the leaching system was circulated through fresh ore a large part of the iron was precipitated, probably as a basic sulphate, and this

proved insoluble even after the solution had been strengthened with sulphuric acid. That basic sulphates are deposited in the course of leaching raw ores is a well-known feature of the Rio Tinto process, and mention of

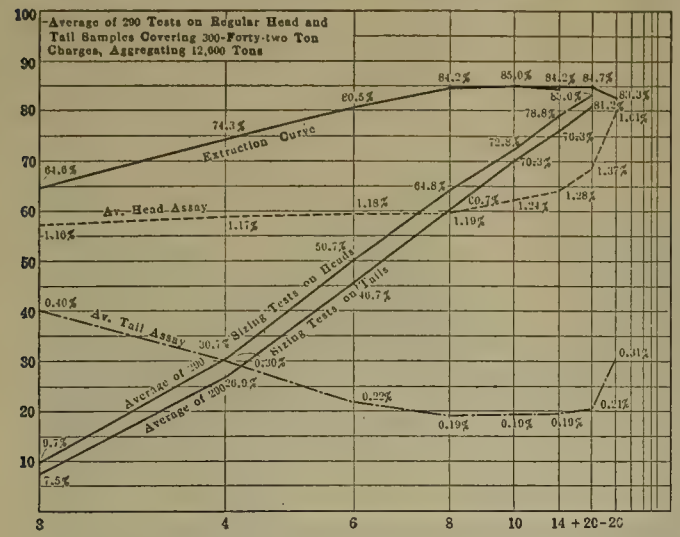


FIG. 1. SIZING TESTS ON NEW CORNELIA OXIDIZED ORE SHOWING AVERAGE ASSAYS OF HEADING AND TAILING AND AVERAGE EXTRACTIONS ON SIZED MATERIAL

the fact was made in discussing the application of that system at Bisbee.[3] The deposition of the basic crust takes place after all sulphide-sulphur has been oxidized, presenting practically the same case as that noted in the effect produced by solutions containing ferrous and ferric sulphates upon the Ajo oxidized ore. In heap-leaching, yellow and brown basic sulphates form abundantly; these are nearly insoluble in sulphuric acid. It is probable that the presence of basic carbonates may facilitate the formation of these insoluble basic sulphates in leaching the Ajo ore. The same tendency to form basic copper sulphate would also be active, but in the great excess of leach-liquor it would be largely taken up, despite its low solubility.

In May 1914 the experimental staff, consisting of H. A. Tobelmann, J. A. Potter, and J. S. Olmsted, was transferred to Ajo, and in February 1915 a 40-ton plant was erected. This was kept in operation until January 10, 1916. The construction of the present large works was begun in March of the same year; it was designed in accord with the flow-sheet established in the experimental plant. Bi-weekly 'leaching-meetings' were held during this period. The entire staff assembled at these conferences, in conjunction with Dr. Ricketts and Capt. Greenway. Invaluable advice in electrical matters was given by Mr. Antisell; Mr. Tobelmann stood sponsor for the chemical work; and Mr. Potter blazed the mechanical trail. Absolutely free speech prevailed at these experience meetings, and a spirit of cordial teamwork was encouraged. One of the staff, viewing in retrospect the conditions under which the early work was done, declared that the pleasurable intellectual excitement of the leaching-conferences even made them forget the boarding-house. As a measure of the hearty spirit of co-operation encouraged by those in authority this confession will be comprehensible to every mining engineer who has helped to unfold the mineral resources of the West. The scheme then developed comprised the following essential points: The ore was to be crushed to $\frac{1}{4}$ in.; the vats were to be of lead-lined concrete with wooden false bottoms bored with $\frac{1}{2}$-in. holes countersunk from below; the solution was to be circulated at the rate of $1\frac{3}{4}$ to 2 gal. per min. per ton of ore; the ore-column was to be 12 ft.; the advance solution was to be 18% of the total in circulation; and the leach-liquor was to contain 3% H_2SO_4, 2% total iron, copper not over 3%, and to have a specific gravity somewhat lower than 1.28. The circulation has now been reduced to 1 gal. per min. per ton of ore; the column is 15 ft., and the other conditions remain practically unchanged. It is an interesting example of

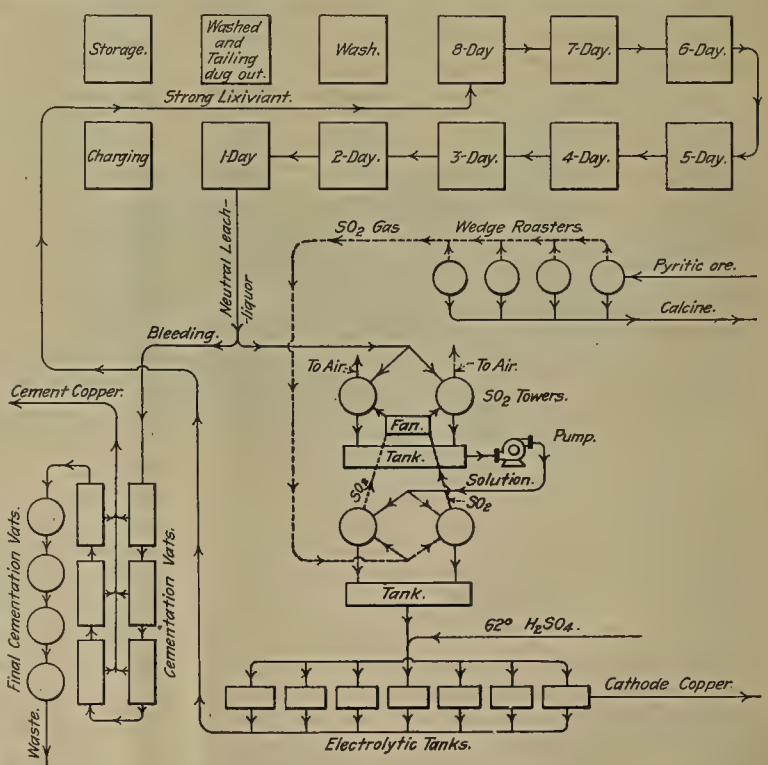


FIG. 2. FLOW-SHEET OF NEW CORNELIA COPPER-LEACHING PLANT

the extreme care exercised by experienced men who engage in mining as a business that, after so elaborate an investigation by so many competent men, the precaution was taken to have the entire process checked in detail by H. W. Morse. The result was a report to the company on January 4, 1916, signed by Morse, Potter, and Tobelmann, recommending the method of procedure outlined above. From the time of starting the 40-ton experimental plant until the final report was made, it had treated 15,000 tons of ore, and had produced 190,000 lb. of cathode copper.

The composition of the ore is given below, one analysis representing the average of various determinations at the laboratory of the New Cornelia Copper Co., with which is compared an analysis of oxide ore made by Utley Wedge, another of the crushed ore in the vat-charges, and, as a matter of interest, a fourth analysis of the sulphide ore, also made by Mr. Wedge.

ANALYSES OF AJO ORES

	Oxidized ore			Sulphide ore
	Average by N. C. C. Co.	Average heading July 1917	By Wedge	By Wedge
	%	%	%	%
SiO_2	66.23	67.83	67.21	66.33
Fe, total	6.40	5.70	4.88	4.90
Al_2O_3	13.75	13.86	12.60	14.40
CaO	0.56	0.64	0.21	0.16
MgO	1.50	1.56	1.66	1.64
MnO	0.14	....	0.19	0.16
S	0.19	tr.	0.08	0.95
Cu, total	2.03	1.671	1.55	1.64
Cu soluble in H_2SO_4	1.84	1.625	....	....
Zn	0.10	....	....	....
Na_2O	3.60	....	....	....
K_2O	4.60	....	....	....
P_2O_5	0.18	....	....	....
Cl	tr.	....	....	....
CO_2	1.30	....	....	....
Gold, oz. per ton	0.01	0.0129	0.005	0.02
Silver, oz. per ton	0.22	0.184	0.40	0.40

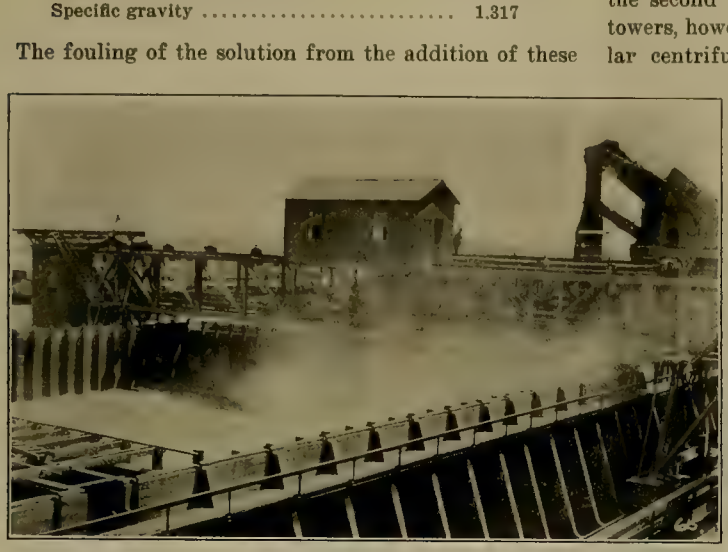
The silica in the tailing distinctly increases in relative amount, and it is found that there is a measurable abstraction of iron, alumina, magnesia, and lime. The average quantity of CaO in the solution is about 0.04%, and the MgO tends to increase. Sulphur increases slightly in the tailing mainly through the formation of sulphates from the sulphuric acid used. The shrinkage in weight of the tailing as a result of leaching is 2½%. The effect of the solution upon the crushed ore is, first, to remove the more brilliant blue and green colors, which practically disappear after 24 hours contact, showing a prompt reaction with the carbonates and silicates. The charge now has become dirty greenish gray, and this color persists until about the sixth day of leaching. By that time the greenish tint has faded from the feldspathic phenocrysts, leaving them nearly white. The sharpest change in color is noticed near the end of the leaching period, that is, on the seventh and eighth days; the charge then looks decidedly bleached, but there is no evidence of disintegration. Nevertheless, the structure of the rock-particles has been broken down, and in a few days they crumble into a mass resembling a clayey sand. When used as ballast or road-metal the tailing consolidates into a moderately coherent cement. The disintegrating effect of the solutions is probably due to elevation of temperature from exothermic reactions as well as from the removal of copper, iron, and alumina, and this may assist in opening passages for the penetration of the lixiviant into the body of the larger particles. It is hardly conceivable that the rock is sufficiently porous to admit of such thorough leaching as was originally obtained on material crushed only to ½-in. size. On the other hand, the fan-shaped fracturing, characteristically present in the larger particles after being crushed in a machine that applies the crushing force radially, may be important in securing good penetration of the solutions. The Symons disc-crushers, which are used for the finer reduction of the ore in the Ajo plant, apply the force in this manner. The relatively slight increase in the percentage of extraction on the smaller sizes as compared with the 3-mesh material is strikingly shown in Fig. 1. The maximum is reached at 10-mesh, where it is 85%, and the extraction curve is nearly horizontal from 8-mesh to minus 20-mesh, decreasing somewhat at the end.

The total volume of solution in circulation is approximately 1,500,000 gal., the rate of flow, or 'advance' as it is locally termed, being approximately 1000 gal. per minute. On entering the leaching-vats it will average 3% sulphuric acid, 2.5% copper, and 2% iron as ferric and ferrous sulphate. It is introduced at the last vat, which holds the charge that is receiving its eighth day of treatment. After upward percolation through this vat it goes through the next vat holding a charge seven days old, and so on to the newest charge, from which it issues practically neutral, and containing 3% copper. It will be observed that no effort is made to precipitate more than one-sixth of the copper content in the solution. In this way the proper strength of the solutions sent to the electrolytic vats is easily maintained. This sixth of the copper content of the solution, however, represents the total copper leached each day; the remainder is merely a fixed quantity always in circulation. It will be noticed also that the leaching is so conducted as to ensure the neutralization of the free acid. The object of this is to facilitate the reduction of ferric to ferrous sulphate in the SO_2 towers, prior to sending the solution to the electrolytic vats, since the absorption of SO_2 by solutions is greatly enhanced when they are neutral. It is important that the solutions on entering the electrolytic department should be practically free from ferric iron. This, as stated previously, is a solvent for freshly precipitated copper, while the ferrous iron functions usefully as a depolarizer. The liquor in circulation is actually quite complex in its composition. From 20 to 30% of its weight consists of sulphates. The complete analysis of a composite sample is given herewith:

Cu	2.635
Fe, total	2.339
Fe, ferrous	1.338

Fe, ferric	1.001
Al_2O_3	2.920
SiO_2	0.022
CaO	0.053
MgO	1.231
MnO	0.035
Cl	0.012
P_2O_5	0.167
H_2SO_4, free and as sulphate	20.86
Specific gravity	1.317

The fouling of the solution from the addition of these various constituents is kept down, not only by virtue of the deposition of insoluble basic salts in the charges, but by the so-called 'bleeding' or diversion of a certain quantity of the total liquors from the circulatory system to the cementation plant, from which it is discarded after precipitation of the copper on metallic iron. Some operators affirm that better results are obtained in electrolysis from liquor that is moderately 'foul,' and the experience at Ajo shows no disadvantageous effects with a solution of the composition given above, but the solvent power in leaching is decidedly lowered when the salts accumulate so as to raise the specific gravity. At the present time the density is being held between 1.28 and 1.3, and efforts are being made to reduce it as near to 1.25 as possible.



AUTOMATIC CHARGING OF LEACHING-VAT; EXCAVATOR WORKING IN ADJACENT VAT

H. A. Tobelmann, the metallurgist of the plant, is assisted in the chemical work by Ben. H. Cody, formerly with the Arizona Copper Co., with a corps of five chemists working in a well-equipped fire-proof laboratory.

During the experimental period, when using the 40-ton plant, the ferric iron was held under excellent control, the consumption of sulphur, introduced as SO_2 for reduction, being 0.78 lb. per pound of copper leached. The reaction upon which the reduction depends is:

$$Fe_2(SO_4)_3 + SO_2 + 2H_2O = 2FeSO_4 + 2H_2SO_4$$

The operation is conducted in a group of four towers, each 40 ft. high by 20 ft. diameter, being a specialized type of Glover tower. The gas enters below and rises against the descending solution. At the top the gas from the first pair of towers is conducted through lead pipes to a large lead-lined centrifugal pump. This produces suction upon the first pair, and forces the gas into the second pair. The flow through the second pair of towers, however, is assisted by suction from another similar centrifugal pump, which discharges the impoverished gas into a stack. The reduction in the towers is now about 70% efficient, and another tower is being erected. It is desirable that the gas be as strong as possible, since its efficiency is thereby increased. At present the gas contains about 7% SO_2 by volume. It is produced in the same manner as for the manufacture of sulphuric acid by roasting pyrite in Wedge furnaces. There are four furnaces with seven hearths each, 22 ft. 6 in. diam. Each furnace is driven by a 7-hp. motor, and is cooled by 20 gal. of water per minute circulating through the arms, and by air delivered to the column under a pressure of 2½ in. water-gauge. The highest temperature is on the third and fourth hearths, where it is approximately 1200°F. The flue-gases from these furnaces are 740 to 760°F.; they pass through a long balloon-flue for cooling, and enter the SO_2 towers at a temperature of about 350° F. After passing through the battery of four towers the gas issues with a temperature of 100° F., and 83% of the SO_2 has been absorbed. A Cottrell treater for the removal of the dust and the 0.2% SO_3 contained had been erected, but at present it is not used. The material roasted is the pyritic ore from the Junction mine of the Calumet & Arizona Mining Co. at Bisbee. It averages 45% sulphur and 3% copper. It is desulphurized to 6% S, and the calcine is shipped to Douglas for reverberatory smelting. The pyrite is crushed through a 13 by 20 in. Blake jaw-crusher, fol-



VIEW OF WORKS; LEACHING-VATS ON LEFT AND CENTRE

lowed by a 48-in. Symons disc-crusher, reducing it to ¼ in. size. A 20-in. belt-conveyor delivers it to gratings set above the drying-hearth of each furnace. The pyrite-crushing plant is driven by a 125-hp. motor. This is entirely independent of the ore-crushing plant. The roasting is done under the superintendence of Herman Snyder. Each furnace roasts 25 tons per day, and three furnaces are in use. The object is to obtain the maximum amount of rich SO_2 gas at the least possible cost, for which reason high elimination of sulphur is not attempted. As a matter of general interest in connection with the quick roasting of pyritic ore the following sizing-test on the calcine is given, the Tyler standard screen-set having been used:

Screen-Analysis of Calcine and Pyrite

Mesh	3	4	6	8	10	14	20	−20
Calcine, weight on screen, %	9.4	4.1	4.1	7.7	7.0	5.5	6.2	55.0
Sulphur in each size, %	14.0	12.3	9.7	7.9	4.9	3.7	2.8	2.4
Raw pyrite, weight on screen, %	4.4	7.8	8.5	8.0	7.9	5.8	7.5	49.9

The operation of leaching is conducted on a scale that has no counterpart in America. The vats are exposed to the open air, and are built in two parallel blocks of six vats each. They are of massive reinforced concrete construction, with walls 8 in. thick, strengthened by concrete buttresses. Each vat is 88 ft. square by 18 ft. deep, having a capacity of 116,260 cu. ft. and holding a charge averaging 5000 tons of crushed ore. The material as delivered weighs 93 lb. per cu. ft., the specific gravity of the solid ore being 2.6. The interstitial volume is found to hold 32 gal. of solution per ton of ore. The bottom of the vat slopes gently toward the solution-launder, which is like an elongated well extending the full width, and is 4 by 5 ft. in vertical section. The entire vat is lined with lead weighing 6 lb. per sq. ft., the sides being protected against wear from abrasion by a lining of 2-in. boards. An interesting incident of the operation of the plant is the boring of a hole through the lead lining by a wood-borer. It was a resistant animal, for it had lived in an acid medium while boring first through the wood and then continuing through the lead. This was proved by examination of the channel cut, and by the finding of the characteristic wood-borer's saw-dust at the point of contact. The hole in the lead showed circular tool-marks as if cut with a fine graver's tool.

The bottom of the vat is protected by a wooden false bottom, made of 2-in. Oregon-pine planks laid close together, and supported on 4 by 12 in. beams spaced 16 in. apart. The boards are perforated with ⅜-in. holes, counter-sunk from below. The solution, forced by lead-lined centrifugal pumps, rises from the well or solution-launder, under the false bottom and issues through the perforations, ascending through a 15-ft. column of ore, and discharging at the ends of the vat over weirs into launders placed between successive vats; thence it passes to another set of lead-lined Worthington solution-pumps, having a capacity of 3500 gal. per minute, which deliver it to the next vat, and so on through the series. These pumps are of the vertical type, having a cast-iron shell, lead-lined, with a cast-iron boot also lead-lined; the shaft has outside bearings, and is encased in lead, while the impellers are made of an alloy of 90 parts of lead with 10 of antimony.

The charging is done with a special machine designed and built by the Robins Conveying Belt Co. It is a type of traveling tripper with conveyor-belt taking its feed from a main conveyor-belt coming from the crushing plant. The spreading-machine travels the full width of the vat, then shifts the width of the belt and reverses the motion, and thus continues until the vat is filled. No hand-spreading is practised. It requires from 12 to 15 hours to charge a vat, with all four units of the Symons disc-crushers in operation. The work of filling is done so well that no serious channeling takes place, except around the sides where the narrow space between the lead lining and the inner protective lining of wood allows too free a circulation. This is being remedied by filling that space near the bottom with asphalt and sand. Some stratification is noticed on digging out the charge, where horizontal layers of dark partly leached material are sometimes found. Discharging likewise is done by machinery. The device used is the Hulitt excavator made by the Wellman-Seaver-Morgan Co. of Cleveland. It is an electrically driven, 14-ton clam-shell digger, operated by one engineer and an oiler. Its total length of travel on the rail is 106 ft., and it is able to rotate through 180° in order to reach the corners of the vat. Twelve hours is required to empty a vat, the tailing being discharged from the clam-shell into cars of 20 cu. yd. capacity, on a track paralleling the series of vats. These are standard gauge cars, and the trains are drawn two miles to the dumping-ground situated in a low area in the desert.

The only additional operation connected with the leaching is that of washing the charges. Each charge receives four washes. The first wash was the second wash of the preceding charge; the second was the third wash of the preceding charge; the third was the fourth wash; and the fourth is fresh water. Every first-wash liquor is returned to the regular circulatory system of the plant, after having been strengthened with sulphuric acid. It contains about 2% copper, as against 2½% for the liquor issuing from the electrolytic plant. The fresh water for the system of leaching is added through the washing of the charges. It comes from a pumping plant eight miles north-east of Ajo, where it is pumped from a well 650 ft. deep. The water on coming to the surface from the desert valley-fill has a temperature of 104° F., and is slightly alkaline, but it contains practically no lime or magnesia. The losses of water from the circulatory system per ton of ore are: By evaporation, 5 gal.; by

tailing, containing 11% moisture, 30 gal.; and by 'bleeding', that is, the discard to keep down the saturation from various salts, 90 gal. per minute, or 25 gal. per ton of ore. This makes a total of 304,600 gal. of water to be added daily.

The electrolytic department is a model of neatness and efficiency in construction and operation. It was designed by A. G. McGregor, assisted by J. A. Potter, who is now in charge of the plant, and by Harry S. Montgomery, the 'tank-house' superintendent. There are 152 vats, of which 25 produce starting-sheets, and 127 yield cathodes. They are made of wood, 48 by 54 in. by 30 ft., lined with lead that weighs 6 lb. per sq. ft. Each cell contains 84 lead anodes and 77 cathodes, 40 by 42 in. The lead anodes are alloyed with 3% of antimony. The starting-blanks are made of lead weighing 225 to 240 lb. The electric current is taken from a D. C. generator driven by an A. C. motor, with 85% efficiency in converting. Two separate and identical circuits are employed in the tank-house, each circuit carrying 15,000 amperes and 90 to 185 volts. The current-density in the vats is 8 amp. per sq. ft., with 2 volts between the anode and cathode. At the current-density maintained, the ferric iron being held below 0.5%, with fouling of the solutions controlled as at present, and realizing an ampere efficiency of 75%, it has proved easy to average nearly one pound of copper deposited per kw-hour. During the first 199 days of operation, that is, up to December 1, 1917, the total amount of cathode copper shipped was 12,894,000 lb.

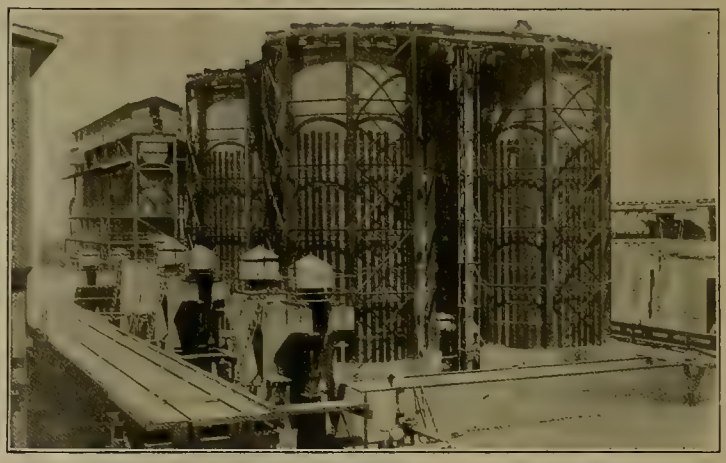
With every pound of copper precipitated, 1.76 lb. of ferric iron is formed. The solution does not always build up the sulphuric acid to the extent that was anticipated. The theoretic increase should be 1.55 of acid per unit of copper, but in the operation at Ajo typical ratios of copper deposited to acid regenerated are as 1:0.7; 1:1.25; and 1:1. The acid is consumed in oxidizing ferrous to ferric sulphate:

$$2FeSO_4 + O + H_2SO_4 = Fe_2(SO_4)_3 + H_2O$$

This makes a heavier demand for fresh acid, all of which is brought in tank-cars from Douglas, where it is made at the recently constructed acid-plant of the Calumet & Arizona Mining Co. One of the problems awaiting solution in connection with a reduction of cost in leaching copper ore is the economical recovery of the acid from the sulphates that are necessarily thrown away in the discarded solution.

As previously mentioned, the Ajo ore contains almost no chlorides, but the water-supply carries 0.015% chlorine. After operating for some time it was found that, instead of increasing, the chlorine content was lowered, while at the same time the cathode-copper showed a small amount of that element. This was a pleasant surprise. The lead anodes remain wholly unaffected, whereas it was expected that they would gradually suffer. In the experiments conducted at the Andes Copper Co., in Chile, with 0.1% chlorine in solution, the lead anodes dissolved and went to pieces.

The electrolytic tank-house measures 168 by 275 ft.; it is merely covered by a roof, the mildness of the climate necessitating no closer housing. The floor is built to a level only a foot below the tops of the vats, and consists of panels of wooden grating. Thus there is no slop in which the men must work. The vats are supported on insulated cement columns rising from a lower cement floor, so that inspection for grounding of the circuit is easy, and leakage and wastage from above can be cared for. The solutions are handled through the plant by Antisell lead-lined centrifugal pumps. The cathodes and anodes are lifted and transported by two 5-ton Shaw overhead traveling cranes. A detail that has added to the economy of operation is a wooden false bottom in the electrolytic vats; this is held in place by lead-clamps burned to the lead lining; it affords a simple and effectual means of saving the bottoms from damage when cathodes happen to fall.



SULPHUR DI-OXIDE TOWERS FOR REDUCING FERRIC SULPHATE

Precipitation of the copper from the discard solution presents nothing new. The ferric iron is not reduced previously, the liquor being sent direct to a series of six concrete vats, and seven wooden launders. The vats have wooden false bottoms, and are filled with cumbrous iron scrap from the smelter at Douglas. The scrap is lifted for cleaning by a locomotive crane. From the concrete vats the solutions flow through seven large wooden launders, filled with scrap-iron, and thence to ponds.

No mention has been made of the crushing-plant, which is notable chiefly for its simple and massive construction. The coarse-crushing section of the Ajo works was designed and built by A. G. McGregor, and the fine-crushing department by David Cole. The ore is delivered from the mine in trains of 20-cu. yd. side-dump cars. Much of it comes in blocks so large that they look as if destined for revetting a breakwater. The cars discharge

their cargo into the hopper of a No. 24 Allis-Chalmers gyratory crusher, capable of reducing 5 by 8 ft. blocks of ore to 6-in. size. From the large crusher the stream of ore splits into four parts, each going to a separate No. 8 gyratory, these forming a quadrangle about the base of the giant machine above. They reduce the ore to 3 in., and it is then carried by two 36-in. Robins belt-conveyors, up an 18° incline 480 ft. to a 10,000-ton steel storage-bin, provided with cross-belts for distributing it. Beneath the bin are four pan-feeders for delivering the ore to as many 20-in. conveyor-belts that carry it to four 48-in. Symons horizontal disc-crushers, made by Chalmers & Williams. Here the ore is reduced from 3 in. to $\frac{5}{8}$ in. Each Symons crusher discharges to a pair of elevators; these deliver the ore to stationary round-punched manganese-steel screens, the oversize returning to the first disc-crushers, and the undersize going to a battery of eight disc-crushers, which give the ore its final reduction to $\frac{1}{4}$ in. size. The main-line belt-conveyor, also 28 in., takes it from this point up a 16° grade to the sampling-tower. This is a Link-Belt system, carrying narrow buckets on chains so as to cut the falling stream of ore at right angles. Thence the ore is taken by a continuation of the main-line belt to the tripper, which discharges it upon the mechanical ore-spreader in the leach-plant.

The power-plant is a splendid achievement of the highest class of modern engineering, and necessitates treatment in a separate article. It is peculiarly interesting as an example of that marvelous efficiency of steam generation which makes it a competitor with the perfected types of explosion engine, even at a point so remote from the source of fuel-oil. It was designed and built under contract by C. C. Moore & Co. of San Francisco, the same firm that built the magnificent power-plant at the Inspiration mine, and that is now constructing the power-station for the United Verde Extension. In outline it consists of oil-fired Stirling boilers generating steam at 240 lb. working-pressure with 100° of super-heat at the throttle of the two big turbines. The turbo-generators each develop 7500 kw. capacity at 80% power-factor. The fuel consumption is 600 bbl. of crude oil per day.

Under the efficient management of Michael Curley, whose early experience in conducting mining operations on a large scale was gained in the iron districts of Michigan, the New Cornelia company is mining 5000 tons of 1.65% copper-carbonate ore per diem, and extracting 80% of the copper.

PLATINIZED ASBESTOS, which is used as a catalyst in the contact method of making sulphuric acid, is made by soaking asbestos in a solution of platinic chloride, drying, and heating to a red heat, when the chlorine is driven off, leaving the asbestos covered with exceedingly finely divided platinum. In the presence of this catalyst at temperatures ranging from 400 to 430° C., 98 to 99% of the SO_2 and O of the air unite to form sulphuric anhydride.

Magnesite as a War Mineral

Until 1915 the United States produced only about 10,000 tons of magnesite annually, although it used 300,000 tons. The domestic supply came from California, and the imported material from Austria, Hungary, and Greece. In 1916 the production in California jumped to 150,000 tons, but the imports, if the calcined material is computed as crude rock, fell to 93,000 tons. Manufacturers of open-hearth steel had difficulty in getting enough magnesite brick to line their furnaces, and companies that made magnesite flooring were short of raw material.

In view of these conditions, domestic production was greatly stimulated. According to estimates by C. G. Yale, of the U. S. Geological Survey, the production of magnesite in California in 1917 exceeded that of all former years, being estimated at 215,000 tons. This quantity and the magnesite produced in the recently discovered field in Stevens county, Washington, estimated by R. W. Stone, of the U. S. Geological Survey, at close to 100,000 tons, makes an output of about 315,000 tons in 1917, or 15,000 tons more than the normal domestic demand. It is believed that the domestic industry hereafter will be able not only to supply the home demand but to produce a surplus for the Allies.

Californian magnesite is mined by open-cuts or underground from veins. The larger deposits are connected with the railroads by spur-tracks or automobile roads. The huge deposits of magnesite discovered in Stevens county, Washington, are only a few miles from a railroad, with a down-grade haul for the load, and are so situated that they can be easily quarried. The Washington magnesite occurs in beds like limestone, in thick lenses up to a quarter of a mile long, exposed on hillsides or ridge tops where large quarries can be opened. Production in this field began with an output of 715 tons of crude magnesite in December 1916. By the spring of 1917 four firms were in the field, and in August the daily shipments averaged 500 tons. The output of Washington crude magnesite in 1917 was between 95,000 and 100,000 tons. Nearly 65,000 tons of this quantity was shipped crude; the remainder was burned by three producers in kilns. Only one company continued production throughout the year; one stopped in August after making a small output, and another began operations in that month.

Magnesite is used not only for making refractory brick and composition flooring, which are its principal uses, but in fire-resistant paint, in the sulphite process of wood-pulp paper manufacture, as a heat insulator or covering for steam-pipes and boilers, in magnesia cement, and for other purposes. Magnesia cement is used for making the decks of ships, the floors of hospitals, and the floors of railroad cars, as well as for floors of larger areas. It has been employed successfully in the European war for making gun emplacements, its advantage being that it sets quickly and has resilience.

Flotation of Chalcopyrite-Pyrrhotite Ore

By WILL H. COGHILL

INTRODUCTION. In 1916 the Bureau of Mines entered into co-operative agreement with the Oregon Bureau of Mines and Geology for the purpose of investigating problems bearing on the treatment of low-grade and complex ores. The writer, as consulting metallurgist, was placed in charge of these investigations, and laboratory room for the necessary tests and experiments was provided at the Oregon Agricultural College, at Corvallis. One of the first problems investigated was the possibility of separating chalcopyrite from pyrrhotite and pyrite by flotation.

Chalcopyrite is the copper-bearing mineral at many places in southern Oregon; in many localities it is intimately associated with pyrrhotite and pyrite. In places these two gangue-minerals form as much as 75% of the ore, so that it is nearly all sulphide.

Gravitation methods of concentrating the copper-bearing mineral cannot be applied because the gangue-sulphides have practically the same density as the chalcopyrite. Magnetic separation does not seem practicable (assuming that the gangue-sulphides can be made to respond naturally or by a preliminary treatment to an electro-magnet) because fine grinding is required to liberate the mineral grains. The methods of concentration now in vogue are hand-sorting and jigging, which eliminate some of the silicious gangue. An inspection of smelter returns gives the impression that the average grade of ore shipped is 10% copper.

TESTS. The work of separating the chalcopyrite from the gangue by flotation has been carried through the preliminary laboratory stage with flattering results. As a mill is never considered complete and finished until the orebody is exhausted and the mill has served its purpose, so in this and other ore-testing experiments there are still undetermined factors. However, in order that those who are interested in the separation of sulphides by flotation may have the results of the laboratory work before them, this preliminary report is published by the Bureau of Mines.

The data in Table I show the results of what might be called progressive tests, or those in which the results were similar to those of successful practice. Many random tests were made to determine the nature of the disturbing influences and how to meet them, but only a few of these are mentioned.

TABLE 1. PROGRESS TESTS

Samples used weighing 1 to 16 lb. and carrying 1.13 to 3.2% copper; ratio of concentration from 8 : 1 to 12 : 1.

No.	Name of mine	Through 200-mesh %	Grade of tailing Copper %	Grade of tailing Percentage of total copper
1	Waldo	54.0	0.45	7.2
2	"	74.6	0.70	20.7
3	"	94.0	0.30	6.1
4	"	92.0	0.50	13.0
5	Morrison	44.0	0.12	6.3
6	"	97.7	0.12	5.0
7	Rowley	82.0	0.25	8.6
8	"	82.2	0.20	6.2
9	Queen of Bronze.	64.5	0.55	...
10	" " " .	?	0.30	23.4
11	" " " .	?	0.26	16.7
12	" " " .	?	0.23	8.1
13	" " " .	95.5	0.55	24.5
14	" " " .	94.5	0.50	20.3
15	" " " .	91.4	0.35	15.1
16	" " " .	92.0	0.90	29.2
17	" " " .	77.5	0.70	16.6
18	" " " .	99.0	0.60	16.1

All the samples were fresh and unoxidized except 16, 17, and 18. These three contained some malachite and azurite; this accounts for the tailings being higher grade than the average.

Several of the tests were made to conform with the tentative flow-sheet (Fig. 1). The results of one that was made in co-operation with D. C. Morris, representing the American Exploration Co. of Grants Pass, are given in Table 2. This sample was crushed excessively fine. It is likely that 75% through 200-mesh would have

TABLE 2. PRODUCTS OF FLOTATION TEST OF QUEEN OF BRONZE ORE IN CALLOW CELLS

Feed assay, 3.0% copper; sample crushed to 99% through 200-mesh; contained oxidized copper.

No.	Products	Weight of product, gm.	Percentage of total weight	Copper in product, %	Gm. copper on 100-gm. basis	Percentage of total copper
54	Concentrate	450	6.0	28.3	1.70	58.5
63	Tailing from middling-cell.....	925	12.3	3.3	0.41	14.1
65	Tailing from cleaner.....	227	3.0	11.0	0.33	11.3
61	Tailing	5940	78.7	0.6	0.47	16.1
		7542	100.0	...	2.91	100.0

7542 gm. = 16.6 lb.

been satisfactory. Callow cells were used, but the Minerals Separation type of machines seemed to give equally good results.

As the work was done with the intermittent type of machines, there were necessarily middling products—63 and 65 in Table 2—that have to be disposed of by approximation, as shown below.

Results. From Table 2, the milled products would appear, on a 100-gm. basis, to be about as follows: No. 63 and 65 containing $12.3 + 3.0 = 15.3$ gm. of pulp would produce a tailing running 1% copper.

Then $15.3 \times 0.01 = 0.15$ gm. copper lost. (a)

This loss added to No. 61 shows a total of $0.15 + 0.47 = 0.62$ gm. copper lost, or $0.62 \div 2.91 = 21.3\%$ of the total copper is lost. Hence the recovery is 78.7%.

These two middling products contain $0.41 + 0.33 = 0.74$ gm. copper.

By (a) 0.15 gm. is lost.

The recovery from them is $0.74 - 0.15 = 0.59$ gm. (b)

Assume that this 0.59 gm. of copper is in a concentrate running 25% copper. There would be therefore $0.59 \times 4 = 2.36$ gm. of concentrate. (c)

The total concentrate would then amount to 6.0 (No. 54) + 2.36 (c) = 8.36 gm. concentrate. (d)

This means a final concentration of 100 into 8.36 or 12 : 1.

8.36 gm. (d) concentrate contains

1.70 (No. 54) + 0.59 (b) = 2.29 gm.

$2.29 \div 8.36 = 27.4\%$ copper in the concentrate.

This method of approximation applied to the tests from samples 1 to 15, inclusive (Table 1), would show an extraction of 90% with an equally high-grade concentrate, except where, as shown by grab-samples of the overflow, the test was stopped too soon. The reader should note in Table 2 that only 15.3% of the charge enters the closed circuit for re-treatment. This quantity, though small when compared with average practice, is excessive for these ores; it was great in this case because the test was prolonged in the effort to float the oxidized copper. The freedom with which the fresh chalcopyrite floats is remarkable. At times there is also a striking play of brassy colors on the overflow.

This reference to color introduces a fertile subject for scientific discussion, but it must be treated briefly here. The first impression was that the color was a true indicator of the grade of the froth. Later work showed that it was not. Sometimes the M. S. type of machine gave a richer looking froth than the Callow type, when analysis showed it to be of lower grade. When the pulps are of equal densities, the M. S. machine gives, without fail, a brassier froth than the Callow. This seems natural because the M. S. machine makes less froth where the bubbles have had more opportunity to gather the chalcopyrite. The burden of chalcopyrite is therefore heavier and more evident than in a Callow machine where the greater number of bubbles—some of them doubtless barren—dart to the surface and form a voluminous froth. The heavy burden of non-wetted mineral carried by the froth stabilizes it by the 'screw-back' effect that the author has discussed in a recent paper.[1]

The Callow froth showed a better color on the concave (upward) surface than on the convex, that is, in the depressions. Although it is true that the weight of the mineral grains should be considered as a factor in causing them to slip down the surface to the lowest point and thus increasing the burden there, the reader should note that the resultant of the molecular forces points in that direction. The fact that the resultant points toward the depression can be emphasized by the following analogy; the physical principles will be discussed at another time. Float a mineral grain in a drinking glass that is thoroughly cleansed so that the water turns up to meet the glass. The mineral will seek the lowest part of the meniscus—the centre. Fill the glass to overflowing so that the liquid surface becomes convex, and the mineral again travels to the depression—this time at the circumference. When floatability is due to the surface-tension film, the floating substance invariably seeks the lowest point on the meniscus.

The ores assay about $2 per ton in gold. The hand-sorting of a Queen of Bronze sample and assaying revealed that about 95% of this gold is in the chalcopyrite. Unfortunately the flotation concentrate contains too small a proportion of gold. It is likely that the gold is embedded in the cleavage-planes of the chalcopyrite and is released on crushing. The gold in the tailing amalgamated freely in bottle-amalgamation tests, proving it to be in the metallic state.

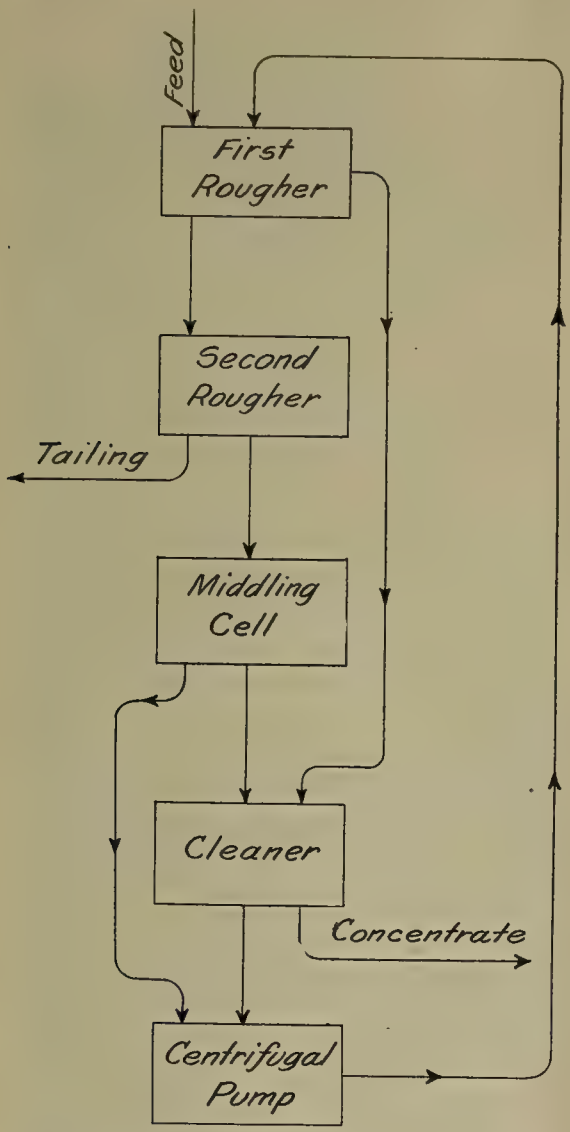
Only one oil was tried. It was selected from a stock of 22 oils on account of its desirable physical properties. The surface-tension effect of these oils had been determined and plotted by E. H. Miller, of the Bureau of Mines, and the one used was found to give a steeper surface-tension curve than any other oil in stock. This was desirable because it was thought that a froth with a slightly variable surface-tension would, with the solids present, be sufficiently stable. Whether other oils would have proved unsatisfactory was not determined, but it is probable that some of them will be found to serve quite well, assisting in some manner other than by reducing surface-tension, but the point is that the oil mentioned is excellent. Its miscibility is an important characteristic.

Only once, and then by accident, was the ore ground in the presence of an insoluble oil. The insoluble oil acted as a collector on all the sulphides present and spoiled the differential separation sought. The overflow carried only 5% copper whereas 30% copper in the first overflow was desirable and expected when the pulp carries 2½%.

As already stated, this oil reduces surface-tension. It seems strange, in view of all that has been written about surface-tension, that there are no published data on absolute value of surface-tension of mill-solutions. In the

[1] 'Flotation,' T. A. Rickard and O. C. Ralston, p. 195 (1917).

course of these experiments several determinations were made by the drop-weight method. One determination gave: Surface-tension of overflow 65.9, of underflow 69.8. This result is in accord with classic tests made to prove adsorption as given in texts on colloid chemistry. The quantity of oil necessary is minute. One-tenth of a pound per ton of ore is ample. It was added to the



TENTATIVE FLOW-SHEET FOR CHALCOPYRITE-PYRRHOTITE ORE

charge in the cell, and the overflow could be drawn after an interval of a few seconds. Neutral water was used.

The process is simple when two 'dont's' are observed.

Don't grind in the presence of an insoluble oil; use it cautiously in any event.

Don't grind samples in a disc pulverizer, and if a ball-mill instead of a pebble-mill is contemplated, make careful tests to see if the iron surfaces have an injurious effect. This is especially interesting in connection with the statements of Zachert[2] and Gahl[3] showing that the influence of iron balls is beneficial.

In the work described in this paper no apparatus was available for determining the influence of iron surfaces in a ball-mill, but it was proved conclusively that, for the flow-sheet used, the disc pulverizer is not only objectionable but must be avoided for either wet or dry crushing. The same conclusion applies to a 'made-up' ore containing chalcopyrite. Two comparative runs were made. Each sample consisted of pulp that had been prepared for cyanide tests, and 30 gm. of chalcopyrite. The copper mineral in one was prepared in the disc machine, in the other it was ground to the same degree of fineness in a porcelain mortar. Table 3 shows the relative floatability. The mineral prepared in the mortar overflowed much more freely and gave a higher-grade product.

TABLE 3. RESULTS OF DISC AND MORTAR GRINDING

Prepared in	Overflow Gm.	Copper %	Copper Gm.
Disc	10	14.0	1.4
Mortar	24	16.2	3.9

This experience leads one to declare the disc-pulverizer guilty until proved innocent.

IN a method for the electro-deposition of copper, proposed by F. E. Studt, and patented in England (British patent 108,688) pure gaseous SO_2 is directly introduced into cells in which Cu is being deposited from acid solutions containing also Fe, sometimes in considerable quantities. Anode polarization and the formation of ferric salts are thus prevented. Liquid SO_2 may, for this purpose, be led into a reservoir whence the gas passes by pipes and cocks to grids of pipes lying on the bottom of the cells. Steam may be supplied also. The pipes on the bottom of the cells are perforated so that currents of the electrolyte are forced along the surfaces of the anodes, preferably so as to cause circulation in a horizontal direction. A low current density, say 13 amp. per square foot, is employed at the anodes. Temperatures of 49 to 53° C. are preferred. Some of the diluted H_2SO_4 resulting from the electrolysis, and containing H_2SO_3, may be used subsequently for lixiviating ore. In order to ensure the reduction of the ferric salts, lixiviation may be prolonged for 10 to 14 hours. The remainder of the acid may be concentrated and heated with sulphur, carbon, or a mixture of such substances, to produce SO_2, which is passed through condensers to remove the moisture, and is then liquefied. About 24% of the gas may be absorbed previously in a tower by the electrolyte between the lixiviating tanks and the cells. Any iron, aluminum, or other sulphate in the acid employed may be decomposed by S. A part of the SO_2 required may be produced by combustion.

[2]Zachert, Victor, 'Beneficial Effect of Grinding with Steel Balls in Flotation," M. & S. P., May 12, 1917, p. 663.

[3]Gahl, Rudolf, 'Hostory of the Flotation Process at Inspiration,' Bull. A. I. M. E., No. 117, Sept. 1916, p. 1656.

The Story of Prussian Blue

By CHARLES S. PALMER

What is 'Prussian blue'? It is a common and useful pigment; a dark-blue solid, with an indigo-like appearance, and a bronze lustre. It is used in making wall-paper, calico, ink, and, in modified form, in common 'bluing' for whitening clothes in washing. 'Bluing' is not identical with 'Prussian blue,' but is a closely related derivative. Then there is 'Turnbull's blue,' another closely related chemical, named in the old trade from its supposed discovery by an Englishman, by the name of Turnbull. All of these names are quite old and respectable.

Now, how and why did Prussian blue happen to get its name? Both the question and its answer are interesting; and it is well to remember that there are no real accidents in the survival of such a good trade-name as this. If this beautiful pigment got its name, it did so because it used to be made first in Prussia, and was shipped thence to other parts of the commercial world. And, it should also be noted that, in Germany, this blue is called 'Berlin' blue, as ordinarily used, with some admixtures, to give it added strength and coloring power; while the pure substance is—strangely enough—called 'Paris' blue, probably because the Germans first discovered and used the art of mixing it with foreign adulterations, to produce justifiably industrial results.

The fact seems to be clear that one Diesbach, with one Dippel, discovered Prussian, or Berlin, or Paris blue. Also, it seems to be clear that this happened in the first 10 years of the 18th century—about 1704, let us say. Also, it seems to be universally agreed by the historians of chemical industry, that this same blue pigment was discovered by accident! By accident? Yes, and here comes our story, for there is a well-defined tradition that helps to show how this 'accident' might have happened. And, it is no discredit to this somewhat apochryphal narration that we are indebted to tradition for the preservation of what well may have basis of real fact in its actual happening, for this is just the way that many of our best discoveries are made—by accident—accident in the hands of attentive and interested observers, who take advantage of mistakes to learn something.

Well, the story? This is how I heard it many years ago from the lips of my revered Professor Harris, back at Old Amherst. It seems that on the banks of one of the rivers near Berlin were several shops and factories for the making of soap, dyes, and so forth. One day one of the soap-kettles was neglected, and burnt its contents to a cinder. The workman, who cleaned up the foul mess, was washing out this unfortunate kettle; as he used the river as a natural sewer for his dirty rinsings, someone noticed that where the rinsings from the burnt soap-kettle mixed with the river there was formed, in the water, a new and strange blue discoloration. The water became blue, and down the side of the river, for many yards, there was the line of the new dark-blue. The thing was strange, and someone determined to find what was the matter. Why should the rinsings from a burnt soap-kettle produce this new blue discoloration in the river-water, which was not different from the ordinary river-water? Not different? Yes, it was different! Above the site of the soap-factory was another factory; and the rinse-water from that factory was found to be peculiarly different from the rest of the river-water farther out where the stream was clearer. Come to think of it, the river was always about that way, somewhat discolored from the customary rinsings from the dye-factory up-stream. But today, with the accident to the soap-kettle rinsings, there was the making of the new blue in the river-water, just where the two kinds of rinsings met. Perhaps the same thing had happened many times before, perhaps just as often as a soap-kettle had been burnt and rinsed out in the obliging river, with its various mixtures of rinsings from all the factories up-stream. Well, the next thing was to ask the people up-stream as to just what kind of old stuff they had been throwing away into the river. Of course they did not know of anything specially queer that they had been doing, except that they had had a lot of some old mordant, green vitriol (sulphate of iron) or something of that sort, which had gone bad; at any rate, the dye-people's answer was enough to set the keen-eyed observer, at the burnt-soap-kettle end, to thinking—and doing.

The story goes on to say that the soap-maker had the wit to try what would happen when one mixed the rinsings from burnt soap-kettles with a solution of green vitriol. The practical chemistry of it all is quite reasonable and clear. Indeed, it would be rather difficult to mix such rinsings, with such antecedents, and not get blue colors with solutions of green vitriol, so, the industrial birth of a new and wonderful pigment came about. But can we vouch for the story? No, for we were not there; but, in some way, someone found out; and the story has all the earmarks of a good historical basis; for it is just the way in which many of the best discoveries and inventions are made, have been made, and will be made, to the end of time. This same Prussian blue is made all over the world, and in many varieties and subtle differences of shade and use. The moral? If there has to be a moral with the story, let another story tell it.

When Sir William Herschell, a German musician who settled in England and became one of the world-famous astronomers, had to make his own telescopes, he made 293 before he got one that suited him, because none of the other 292 was quite good enough. When this same Herschell discovered the planet Uranus, he was simply making a systematic survey of all the stars, and at first he thought that he had found only a comet; and he used to say that he was like old Saul, the first king of biblical Palestine, who "went out to seek for his father's asses, which were lost, and found a kingdom."

PRUSSIAN BLUE is quoted at 67c. per lb., with the demand exceeding the supply.



The Mountain



The Hacienda

Potosi

By MARK R. LAMB

It is bad enough—even disgraceful—to have to admit that the tin mines and the copper mines of Bolivia are not American-owned, especially as our representative mining men have had an opportunity to know the important properties. But to allow Potosi, the biggest mineral deposit in the world—bigger than any iron mine, we know—to allow such a deposit to remain with its present owners is nothing short of a crime!

The mountain has been looked over in a half-hearted way by a number of engineers and promoters, but they not only failed to appreciate the mine, but have failed utterly to appreciate the ideal legal conditions surrounding the property, and this in spite of the fact that Don Luis is gradually absorbing the mountain before their very eyes.

In order that the reader may grasp conditions, I shall begin by saying that all geologists and near-geologists are proud to admit that the big wide veins of solid silver worked by the early Spaniards (none of your low-grade 1000 or 2000-oz. ore) were merely the surface ramifications and fissure-fillings at the top of the main deposit. Anyone who has been to Potosi can make you the sketch of the vein-formation of the mountain. It resembles the upper half of a spider's web with the 'parlor' below the present workings and somewhere below the base of the mountain. All the veins (in the imaginary sketch) tend toward a common centre—and *what* a 'parlor' this will be!

The early miners were only after silver; the tin merely bothered them. All the old tailing has been accumulating for years for Mr. Lawrence and his friends, who will have them out with a dredge in a short time.

Those solid silver veins required special laws. It will be readily admitted that to give a claim of any considerable area of ground on such veins to one man would be unfair to the rest, so it was arranged to allow the workings of the veins on a simpler and much fairer basis. It is only necessary to go upon the mountain, and use good judgment in picking out a mine (there are thousands) formerly worked and now abandoned and begin work—just like that! You pay two dollars and can work anywhere your vein leads you so long as you do not break into any adjoining workings, and likewise no one else can break into your workings. Of course, an occasional shot will break through, especially as the surveying is not kept up close (this is a joke, as only Don Luis surveys his mine), but this simply means the building of a wall to separate you from your neighbor, and you continue on your way, and he his.

My mine cost me two dollars, and I am the potential owner of all the silver and tin below, between, around, and above the other miners on the mountain. They only own the ore they have broken down and any block which they have prepared in such a way that I cannot get at it

without breaking into their workings. Preparing such a block is not very difficult because all I require is to know where it is, in order to drift and cross-cut to it. It is then only necessary to take it out first, to be the owner. So you see, the mountain is really mine potentially with the cubic miles of tin and silver ore which form its base, and which have not been touched! My only problem is to get the ore first.

The plan is to use a two-dollar mine as a basis for promotion and perhaps allow the Socavon, Bebin, and Soux to come in just to make things easier for them. To include them in the promotion is not necessary, as all that must be done is to supply equipment to develop faster than they can. I can thus run circles around them and make their mining unprofitable. This is not theory—it is present practice.

After I have capitalized my mine reasonably along modern lines, I shall have funds for a huge power-plant of Diesel engines, compressors, and drills, and it will be a simple matter to sink faster than anyone else, and stope faster, and thus own Potosi. I will put up a huge mill of crushers, ball-mills, and 500 tables (one of each kind). Why, tin concentrate will be as plentiful as sand, and silver will be as cheap as tears are now in Europe!

Does this sound fanciful? It is exactly what Don Luis Soux is doing on a small scale at the present moment. It is exactly what Bebin Hermanos could do, if they were so inclined. It is precisely what was planned by the originators of the Socavon.

Don Luis told me that he had only located one mine. And he is rated now at—well, he could have helped materially in the over-subscription of the Liberty Loan. The other mines he has naturally came to him by purchase, abandonment, etc.—principally, etc. Don't forget that legally, anything he can take out of the mountain is his, and still there are people—American engineers, geologists, and promoters—who worked hard to change this law! Pressure was brought to bear on the Bolivian Congress and President, urging the good of the country—but it was found to be impossible—on account of vested rights, much as everyone wanted the change made—except the present owners.

If you have grasped the situation, you can realize what an opportunity this is for a Clark or a Jackling, a Guggenheim or a Braden.

Taking all the ore in sight is legal. There are no side-lines, nor end-lines, nor top, nor bottom.

SPELTER imported into China in 1914 amounted to 1,145,600 lb., with an approximate value of $150,000. Of that amount more than 57% came from Germany and Austria-Hungary, and more than 40% from Great Britain and Hongkong. In 1915 only 36,800 lb., valued at $15,176, was imported, of which nearly 98% came from Hongkong. In 1916, 87,200 lb. was imported, at an approximate value of $43,185, and more than 89% of this amount came from Japan. Zinc sheets and plates bought by China in 1914 amounted to 1,229,067 lb., 33% coming from Belgium, 28% from Great Britain and Hongkong, and more than 17% from Germany. In 1916 this item was reduced to 835,467 lb., valued at $372,200, of which more than 65% came from the United States, and more than 16% each from Great Britain and Japan. Nearly all dealings with consumers in China are through importing houses, of which there is a large number. American firms generally deal through importers who have connections in the United States, thus facilitating settlements through these connections.

Solder

The highest grade of solder is the eutectic alloy, which contains 66% of tin and 34% of lead. This alloy is expensive, however, and what is known as 'half and half' is the most favored alloy. The presence of a small amount of antimony improves the appearance of solder, but renders it less fluid and impairs its adhesiveness. Some specifications require a minimum of 45% tin and 55% lead, with not over 0.5% antimony. Such an alloy is supposed to be the equal of the regular half and half, and is cheaper. Wiping solder is sometimes made of lead 60% and tin 40%, with a maximum of 0.5% impurity. The regular wiping solder contains about 66% lead and 34% tin. To make the solder from scrap lead and tin, such as old pipe and sheet, the metals can be weighed and melted together in an iron kettle such as is used for making babbitt. The fluid alloy should be thoroughly stirred and can be dipped out of the kettle by iron ladles and poured into strip molds. The metal should be allowed to become rather hot and then stirred for a considerable period with a stick of green wood. The addition of resin and tallow will reduce any scum to dross. When poured into the molds the slower the metal sets the better its surface, therefore marble molds are sometimes used instead of iron.—'Daily Metal Reporter.'

Japanese Sulphuric Acid

Since the beginning of 1917 the price of sulphuric acid in Japan has been steadily advancing owing to increased exports to Russia and China, and also to the Allies for war purposes. As a result, some of the fertilizer companies have reduced their output and have devoted their energies to the manufacture of sulphuric acid, while a number of new companies has been established exclusively for the manufacture of that chemical. The present total output of the country amounts to 582,500 tons per year. Of this quantity, 412,150 tons is consumed by the manufacturers themselves in the production of sulphate of ammonia, hydrochloric acid, and other substances, leaving the remaining 161,150 tons available for general requirements. The domestic demand now amounts to about 100,000 tons per year, so that the quantity for export is about 60,000 tons. It is estimated that the output of sulphuric acid in Japan, if turned out at the present rate, will be in excess of the demand by about 100,000 tons on the return to normal conditions.

Zinc Industry in 1917

According to the best information available to the U. S. Geological Survey the recoverable zinc content of ore mined in the United States in 1917 was about 690,000 short tons, compared with 702,610 in 1916 and 605,915 in 1915. The Joplin area gained nearly 20,000 tons in output. This gain was made during the early part of the year, however, for the increasing cost of operating in the sheet-ground districts, and the declining price of concentrates, caused practically all those mines to close, reducing the output of sheet-ground concentrate from a weekly average of 3000 tons in 1916 to an average of about one-third of that quantity in recent weeks. This loss, which is permanent, involves a net reduction of the zinc resources of the country of over 50,000 tons of recoverable zinc per year, as well as of lead concentrate containing 15,000 tons of lead.

New Jersey increased its output over 10,000 tons, the upper Mississippi Valley region gained 5000 tons, and Arkansas made a creditable increase. Montana fell off nearly 25,000 tons, the loss being due largely to the strike in the Butte district. Colorado lost 10,000 tons, Utah 5000 tons, New Mexico 4000 tons, Idaho and California 3000 tons each, and Nevada 2000 tons. Of the total production, the Eastern States contributed 154,000 tons, or 22%, the Central States 293,000 tons, or 43%, and the Western States 243,000 tons, or 35%; in 1916 the corresponding quotas were, Eastern States, 20%; Central States, 38%; and the Western States, 42%.

The following figures have been compiled, without change, by C. E. Siebenthal, of the U. S. Geological Survey, from reports furnished by all active smelters of zinc ores.

SMELTER CAPACITY REDUCED. Owing to the depression in the spelter industry and to the necessity of curtailing production, two plants in Kansas, one at Chanute and the other at La Harpe, have been dismantled, and nine more plants in Kansas and Missouri soon will be. Twenty zinc smelters were not in operation. The second column in the following table shows the maximum retort-capacity by States before any plants were dismantled.

ZINC-SMELTING CAPACITY RETORTS, 1917

State	Total	Operating Dec. 15	Idle Dec. 15	Under construction
Illinois	47,568	34,232	13,336	...
Kansas	44,054	11,826	29,406	...
Oklahoma	77,899	50,491	27,408	...
Other States	60,090	41,242	18,848	840
	229,611	137,791	88,998	840

Accordingly 88,998 retorts out of 225,637, or 40%, were idle. In a number of cases additions to capacity planned early in the year were abandoned. The only retorts now under construction are a block of 840 at the Terre Haute, Ind., plant of the Grasselli Chemical Co. The new smelter of the United Zinc Smelting Corporation, at Moundsville, W. Va., has two blocks of 1728 retorts completed, but they have not been put under heat. The acid plant, however, is in operation. The smelter and acid plant of the American Zinc & Chemical Co., at Langeloth, Pa., is closed indefinitely on account of a strike. The furnaces and kilns are under repair. Three smelters with acid plants in Illinois are operating at half capacity on account of the difficulty of obtaining zinc concentrate owing to the freight congestion.

PRODUCTION STATIONARY AT LOWER PRICES. The production of spelter from domestic ore in 1917 is estimated at 574,994 short tons, worth, at the average St. Louis spot quotation, about $102,350,000, and the production from foreign ore was 92,757 tons, a total of 667,751 tons, worth $118,860,000, compared to a total of 667,456 tons in 1916 (563,561 tons of domestic origin, and 104,005 tons of foreign origin), worth $178,878,000 at the average St. Louis selling price. This indicates practically the same production as in 1916, but a loss of more than $60,000,000 in value. Included in the output is 28,175 tons of electrolytic spelter, of which part was refined by electrolysis from prime Western spelter. This was the product of five plants. The quantity of zinc-dust prepared for market was over 7000 tons. The output of secondary spelter re-distilled at regular smelters and at the smelters with large retorts was about 21,600 tons. Primary spelter was produced during the first half of the year at the annual rate of 722,000 tons, during the third quarter at the rate of 626,000 tons, and during the fourth quarter at the rate of 600,000 tons. The production of primary spelter from both domestic and foreign ores, apportioned according to the States in which it was smelted, by six-month periods, was as follows:

SPELTER PRODUCTION BY STATES

	1916		1917	
State	First half	Second half	First half	Second half
Illinois	90,082	90,268	95,149	79,668
Kansas	74,592	65,924	42,359	33,269
Oklahoma	73,298	90,790	109,130	89,389
Other States	78,480	95,054	114,500	104,287
	316,452	342,036	361,138	306,613
	658,488		667,751	

IMPORTS REDUCED; EXPORTS STATIONARY. The imports of spelter (mostly scrap) are estimated at 270 short tons, valued at about $25,000, compared with 684 tons in 1916. Zinc-dust was imported to the amount of 380 tons, worth $90,000. The imports of zinc ore in

1917 were approximately 215,000 short tons, containing about 75,600 tons of zinc and worth about $4,550,000, compared with 385,964 tons of ore, containing 148,147 tons of zinc, in 1916. The imports of zinc ore in the first 10 months of 1917 originated as follows:

IMPORTS OF ZINC ORE, JANUARY TO OCTOBER 1917

From	Ore short tons	Zinc content short tons	Value
Canada	14,554	4,362	$ 294,669
Mexico	130,090	41,853	2,574,129
Spain	14,778	6,083	260,922
Italy	5,919	2,411	117,271
French Africa	1,246	623	66,346
Australia	27,731	12,502	753,598
	194,318	67,834	$4,066,935

Exports of spelter and sheets made from domestic ore are estimated at 144,000 short tons, worth $37,000,000, compared with 163,137 tons, worth $51,312,990, in 1916. Exports of spelter made from foreign ore are estimated at 60,000, valued at $11,900,000, compared with 43,230 tons in 1916. The exports of zinc manufactures fell off to $400,000 in 1917 from $572,286 in 1916. The exports of brass are estimated at 169,000 tons, valued at $104,300,000, compared with 122,466 tons, worth $72,683,626, in 1916. Manufactures of brass were exported to the value of about $134,500,000, compared with $241,668,081 in 1916. The value of loaded cartridges exported in 1917 was about $41,000,000, against $55,103,904 in 1916.

CONSUMPTION AND STOCKS. The apparent domestic consumption of spelter in 1917 may be computed as follows: The sum of the stock on hand at smelters at the beginning of the year, 17,598 tons, plus the imports, estimated at 270 tons, and the production, 667,751 tons, gives the total available supply, namely, 685,619 tons. From this are to be subtracted the exports of domestic spelter and sheets, 144,000 tons, the exports of spelter made from foreign ore, 60,000 tons, and the stock on hand at smelters on December 5, of 50,107 tons, or a total of 254,107 tons, leaving a balance of 431,500 tons as the apparent domestic consumption. This calculation takes no account of stocks of spelter held by dealers or consumers. This shows a decrease of 28,000 tons from 1916. The normal ante-war consumption of spelter in the United States was about 300,000 tons. The stock of spelter on hand at smelters, in transit, or in the hands of agents December 15, 1917, was 50,107 tons, as compared with 17,598 tons on hand or in transit January 1, 1917, with 33,147 tons June 30, and with 47,186, September 30.

DECLINE IN PRICE. The price of spelter at St. Louis started at 9.75c. per pound, and after receding to 9c. at the middle of January rose gradually to 10.75c. early in March. The price dropped to 8.9c. late in April, rose gradually to 9.4c. by the end of May, but, in a series of declines, with short recoveries, reached 7.75c. near which it closed the year. The average quoted price for the year for prime Western spelter at St. Louis was 8.9c. per pound, as compared with an average sales price for all grades of 13.4c. per pound in 1916, and 12.4c. in 1915.

Determination of Sulphur in Pyrite

*The following modification of Lunge's method is recommended. Place 1 gm. pyrite, finely ground and sifted, in a porcelain crucible; treat with 20 cc. HNO_3 and 5 cc. HCl; cover with a watch glass; allow to react at the ordinary air temperature, and when no more nitrous fume is given off, evaporate on a water-bath to dryness; add 5 cc. concentrated HCl; again evaporate to dryness and add 100 cc. distilled water and 1 cc. concentrated HCl; precipitate the Fe with 10 cc. NH_4OH (d.o. 91) and heat the whole at 60 to 70°C. for 10 min.; the Fe separates out completely. Decant the solution, wash with boiling water so that the filtrate may amount to almost 250 cc.; cool, and make up to 250 cc. (solution A). Remove the preparation from the filter by means of a spatula (without breaking the filter); place in the same crucible as before, and dissolve in the least possible quantity of concentrated HCl. Pour the liquid upon the same filter, and collect the filtrate in another 250 cc. flask, using a few extra drops of acid. Thoroughly wash the crucible and filter with boiling water so as to fill the flask about one-third full. Re-precipitate the Fe in the solution with 10 cc. NH_4OH (d.o. 91); cool, and make up the solution to 250 cc. (solution B). Take 100 cc. of solution A and 100 cc. of solution B, in a beaker; neutralize with diluted HCl, using methyl orange as indicator; and 1 cc. concentrated HCl; boil, and add 100 cc. boiling 2% solution of $BaCl_2$ at one time. Let the preparation stand one-half hour; decant, add 100 cc. boiling water; allow to settle, and filter. Repeat this three or four times, continuing the washing until 5 cc. of the filtrate will give no precipitate with H_2SO_4, nor even a turbidity. Dry, ignite as usual, and weigh.

ZINC OXIDE, a white powder, which is manufactured on a large scale in New Jersey, has an important use in the rubber industry in addition to its use as a pigment in the paint industry. It is employed to increase the tensile strength of manufactured rubber. According to one authority, a mixture of pure rubber, after being vulcanized with sulphur, has a tensile strength of about 2000 lb. per square foot and an elongation of 960% of its original length. The effect of adding zinc oxide is to increase the tensile strength but to diminish the elongation, as shown by the following table:

Zinc oxide %	Tensile strength Lb. per sq. ft.	Elongation %
25	2400	720
35	2400	700
45	2700	680
55	2500	620
65	2000	540
75	1300	400

It will be seen that up to about 60%, zinc oxide increases the tensile strength of rubber. This effect is said to be greater than that obtained with other mineral fillers. Lithophone is its chief competitor.

*Abstract: C. Zay, Staz. Sper. Agrar. Ital.; XLIX, 530; 1916.

Mining in Colorado

By ARTHUR J. HOSKIN

January shows what will probably prove the lowest point of this winter's mining activities in Colorado. The unusually mild weather prevailing in the State during the early part of the winter permitted operations at many alpine mines that generally close down in October or November. The season for all such properties was, however, effectually closed soon after New Year's day and miners are guessing whether the spring will come earlier or later than usual. Reports are already coming in regarding the running of snowslides, the toll including two miners in the San Juan region. Cripple Creek suffers the least, among Colorado mining districts, from wintry conditions; and this month's production will probably show up better than corresponding outputs for several years past.

The Derry Ranch Gold Dredging Co. maintained steady dredging activities until December 15. This is the company that, late in the summer of 1916, erected a dredge on a hay-field between Leadville and Twin Lakes, working two months that first season and about six months during 1917, recovering sufficient gold within the first three operating months to amortize the entire investment in land and equipment. The holdings comprise about 1800 acres, although no claim is made that the pay-channels cover more than a small fraction of this acreage. The ground that has been worked and that was selected as the best has shown recoveries varying—during monthly runs—from 20 cents to 50 cents per cubic yard. The 1917 production of gold by this company is said to have averaged $15,000 per month.

Attention among mining-men just now is divided between two comparatively new Colorado industries, each of which shows signs of permanence. These industries are the mining and concentration of molybdenum ore and the excavation and distillation of oil-shale. Several substantial close corporations are conducting research to decide upon means for making best profits from the oil-shale deposits in western Colorado. There are numerous other companies that will probably never get beyond the stock-peddling stage for the reason that they are not fostered by men possessing the ability or the notion of legitimately conducting such enterprises. There have been so many fake oil-company promotions in Denver during the past year that investors pay little heed to oil-shale promoters and the expectation among disinterested persons is that most of these weak concerns will not survive the winter or be in shape to proceed commercially when the spring drive starts. This is not written to belittle the oil-shale industry. On the other hand, the opinions of the Government and State geologists concerning these tremendous resources are in accord. There can be no doubt that success will attend those companies that have the means, the technical staff, and the management to push development of properties and the erection of plants on the necessary scale. Several inventors are developing processes for distilling numerous valuable hydrocarbons from these shales and recovering by-products such as ammonia and potash. Two such inventions have been definitely selected by some of the substantial oil-shale companies, these processes being known as the Galloupe and the Chew, from the names of their respective inventors. Other companies intend to install the Scotch process. Very little is being accomplished upon the ground for the reason that it is blanketed by two to four feet of snow. Engineers for several Eastern investors are awaiting the favorable season for making investigations.

The other new industry referred to is that of molybdenum mining and reduction. It is true there has been more or less work of this kind in Colorado for years past and that the Primos Chemical Co. undertook to conduct molybdenum mining upon a commercial scale three years ago in Clear Creek county; but, for various reasons, the chief of which was litigation, the industry has not thrived. The Primos company is credited with having mined, during 1917, molybdenum ore having a gross value of $250,000 and it is said that in 1918 production bids fair to be considerably greater. About two years ago an attempt was made to commercialize certain great masses of low-grade molybdenite ore occurring on the crest of the continental divide close to Fremont Pass and the line between the counties of Summit and Lake, at the station of Climax on the South Park branch of the Colorado & Southern railroad. A shipment of 1000 tons of this mineralized porphyry was made to Leadville—a few miles south—and sampling proved its molybdenum content to be 1.14%. At that time, however, sufficient interest could not be aroused by the promoters of the project to secure the capital needed for a plant. At that time the concentration of molybdenum ore had not reached the degree of perfection that stands back of the present interest in this business. Two companies have secured large holdings at Climax and have erected milling-plants. One of these, the Molybdenum Products Corporation, is to use a process of concentration developed by M. S. MacCarthy, of Denver, and it has shown remarkable progress in its mining development and plant erection despite many obstacles arising from war's disturbance to delivery of machinery and supplies. The first unit, which is practically completed, has an estimated capacity of 100 tons, but it is so planned as to admit of easy enlargement. An aerial tramway has been

erected to transport the ore from its source above timber-line down to the mill, which is beside the railroad a few feet below timber-line. Details of the MacCarthy process are not available, but it is said to involve new principles in concentration, to operate inexpensively, and to produce high-grade concentrate at one operation. The concentrate will be reduced in another plant owned by the same company in Denver.

The mining of molybdenum has aroused new interest also in that portion of Gunnison county tributary to the town of Pitkin. As yet but one concern is producing from the fissure deposits, this being a partnership comprising William J. Candlish, C. E. Savery, and William E. Cramer. A large amount of run-of-mine from a 12-ft. vein has been shipped to Denver, where it is being concentrated in a small experimental plant designed especially for this purpose. The raw ore is white massive hard quartz, the molybdenite occurring along myriad fractures and in vugs. The ore runs about 4% molybdenum. Treatment in this mill involves crushing, ball-mill grinding, and oil-flotation in a six-cell Ruth machine.

The Colorado Metal Mining Association and the Colorado chapter of the American Mining Congress are holding a joint annual meeting this week in the Capitol building. The sessions draw good audiences. Among subjects up for discussion are the Federal establishment of a price for silver, oil-shales, and the re-opening of the withdrawn oil-lands of the West. Senator Key Pittman of Nevada spoke interestingly upon the last subject. Governor Emmett D. Boyle of Nevada handled the silver question in a scholarly address that advised the mining men to boost for the last bill that has been introduced at Washington, notwithstanding the objections that may be entertained by Westerners. The subject of oil-shales was covered by Dr. David T. Day of the U. S. Bureau of Mines. Other speakers include Fred Carroll, State Commissioner of Mines, Senator J. B. Kendrick of Wyoming, Bulkeley Wells, D. A. Lyons of the Bureau of Mines, and Dr. R. D. George, State Geologist of Colorado. An incident of the first day's session followed the reading of a paper written by Victor C. Alderson on 'The Experimental Plant at the Colorado School of Mines.' The discussion following President George M. Taylor's reading of the paper took the form of decided criticism of the manner in which the affairs of the school have been mismanaged during the past year, with special protest against the usurpation of the presidency by Dr. Alderson, whose masterpiece, the experimental plant, was declared fit material for the junk-heap. Arguments were presented urging the removal of the school from Golden and making it a department of the State University at Boulder.

Sulman and Picard have patented a method of extracting lead from ores, consisting of bringing the lead into the form of a sulphate by a suitable roast, and dissolving it with a solution of common salt. The lead is then precipitated from the filtrate by sodium carbonate. Zinc present in the calcine as sulphate is also dissolved, and in the process of precipitation the lead is thrown down first with a weak solution of sodium carbonate, while the zinc remains in solution. The addition of a further amount of the sodium carbonate will then precipitate the zinc. A variant upon this procedure is to leach the zinc oxide and sulphate from the calcine with dilute sulphuric acid, and then treat the residue with salt-solution to recover the lead.

Wolframite in Argentina

One of the important wolframite deposits of Argentina is in the Province of San Luis, which lies between the Provinces of Córdoba and Mendoza, in the west-central part of the Republic. A detailed account of the deposit is given in Boletin No. 3 of the Dirección General de Minas, prepared by Roberto Beder. The ores are associated with magnetite in quartz pegmatite veins traversing crystalline schists on the western slopes of the Cerro del Morro. The schists have been identified as belonging to the lower Silurian, and they have been disturbed and altered by intrusion of granite, followed by andesitic eruptives. The acidic intrusives cross the schistosity of the overlying formation, for the most part having a north-northeasterly course. They consist of aplite, pegmatite, micaceous quartz dikes, together with dikes of pure quartz and some with tourmaline. No basic dikes are found with these acidic intrusives. The wolframite is found in the micaceous quartz dikes, and some of the pegmatites contain large amounts of magnetite and martite. For the most part the iron is present as martite, which is pseudomorphic after magnetite. The wolframite veins are from two to four feet wide, but the quantity of tungsten mineral bears no relation to the width of the quartz masses. It is most abundant in the quartz, and is not associated with the mica. It is gray to yellow and brown in color. The distribution of the wolframite is irregular, and in the richer deposits will not exceed 1 to 1.25% of the ore. Generally these enriched portions do not extend more than six to twelve feet along the length of the dikes. Apatite and fluorite are fairly abundant as accessories. Other occurrences of wolframite are known in the Sierra de Córdoba, which have been described by Bodenbender in a bulletin on the mineralogy and mining of that region issued by the Argentine bureau of mines in 1905.

Pyrrhotite deposits, containing 42 to 50% Fe, and 26 to 35% S, are found in the State of Maine. At the Katahdin iron mine, after having utilized the oxides in the gossan as an iron ore, the pyrrhotite was found beneath, and the deposit, as now developed, shows about 5,000,000 tons. The length of the orebody is 2300 ft., the width varies from 300 to 700 ft., and the lower workings are in pyrrhotite of undiminished grade.



NEW YORK

Coal and Ice Shortage.—Gas Production.—Freight Movement.—Sharemarkets.—Food Prices.—Labor.

As New York is the vital centre of the United States, the following observations should be apropos:

The second heatless holiday, affecting about 2,000,000 wage-earners and an army of salaried officials, was characterized by the same apathetic compliance with the new regulations that marked the observance of the previous 'blue' Monday. The outlook remains the same, with no visible relief in sight. Coal receipts are not up to expectations. Additional cold spells are making harbor conditions worse, and piling up difficulties in the way of any immediate realization of hopeful prognostications. Landlords are not losers by the new regulations, and with increased rents and prompt compliance with patriotic appeals to reduce coal consumption to a minimum they manage to consider everybody but their unfortunate tenants. That the present tie-up was fully anticipated by those who had studied the problem of supplying New York's daily needs is seen in the fact that as far back as 1908 it was suggested that an immense storage-yard should be provided in the New Jersey meadows, and that this should be connected by tunnels to New York City and Brooklyn. For next winter it is proposed to store 500,000 tons of coal on Staten Island in the harbor. The cost of the scheme was against its adoption but had steps been taken along those lines, and the present crisis passed without recourse to the drastic methods now in vogue, the preliminary expense would have been more than justified. The great service corporations in New York operate on the 'hand to mouth' principle with reference to coal supply, and this fact was brought home to the public in a realistic fashion last August when the arrival of a coal-barge at the wrong wharf caused a tie-up of the Interborough Transit Co. system and inconvenience and loss to hundreds of thousands of persons. The prospect of success in a gamble which views with complacent optimism the possibility of a mild winter or a cool summer in New York is indeed small.

Ice is just as much a necessity in the summer months as fuel is in the winter. A warning has already been sounded that there will probably be a rise in price of this commodity, with every prospect of a serious shortage as soon as consumption increases. There are economic difficulties in the way of harvesting a sufficient supply of the natural ice of the Hudson river at the present time. Labor is expensive and storage facilities are lacking. The controlling companies are also disinclined to cut any more ice until they are certain of the market. The supply of the artificial product may be considerably curtailed if the Government follows its proposed intention of controlling the production of ammonia for munition and other war purposes. Like the coal shortage, the ice situation will doubtless receive due attention in the proper season.

The prospect of efficiently operating the industrial mechanism of New York under existing conditions is as feasible as trying to run a reduction plant without ore-bins. The only attempt made to provide against abnormal conditions must be credited to the gas companies who for several weeks past have been selling $30,000 worth more gas daily than they did during a similar period last year. Had it not been for this reserve the suffering would have been still more acute; and the new Tammany Mayor threatened to seize this stock which kept the people warm by producing gas! There is, however, another side to the question. Gas-heating appliances consume much air and produce a vitiated atmosphere. Absence of ventilation has been the cause of much sickness and generally unhealthy conditions, a state of affairs fostered and encouraged by "A message to householders from the United States Fuel Administrator," in which the following unhygienic methods are enjoined: "Do not cool off house by opening windows;" "Weather strip your windows or stuff cracks with cotton." As the building laws have apparently never considered it worth while to insist on efficient ventilation, the effect of hermetically sealing living and sleeping rooms in an effort to carry out the Fuel Administrator's wishes can only result in an appreciable lowering in the stamina of the people, with a still greater prospect for the effective spreading of infectious complaints.

A prominent New York business-man has made the following suggestions to Mr. McAdoo to relieve the freight congestion in and around the city:

"Define and establish sites for the erection of sidings on all main railroad lines as ready-freight yards, approximately one hour's freight distance from terminal and seaboard points.—Build on such sites railroad sidings arranged for ready-freight sheds, with railroad track on one side and wagon road on the other side.—Build trackside ready-freight sheds.—Cantonment camp builders to erect sheds.—Place such sheds under military guard.—Whenever necessary, during labor shortage, with the co-operation of the nearest military forces, detail the needed number of soldiers to load and unload, following the precept of foreign countries in this respect."

He claims that the adoption of the scheme will cure the present congestion and that if the plans are carried out:

"They will save daily thousands of car-days.—They will clear the tracks for food, fuel, and priority freight.—They will guarantee the necessary speed for the movement of goods abroad.—They will prevent the interruption of domestic business.—They will speedily eliminate the necessity for embargoes.—They will collect merchandise for home industries at points reasonably available at terminal cities."

Public confidence is usually reflected in the condition of the sharemarkets, and the hardening of prices during the past week may be attributed to the fact that a feeling of relief is prevalent that the most drastic step that could be taken is now a matter of history. The public may be forgiven for a complacency which assumes that the worst is over.

New York newspapers have acted in harmonious unison in raising the price of their evening papers to two cents per copy. The sole exception is the 'Evening Post,' which is reduced from three to two cents—a progressive step which places a journal of high standing within the reach of a wider circle of readers. The increase in price of the other papers led to an immediate though ill-organized strike of dealers who objected to being excluded from a share of the spoils. The strike has fizzled-out without the granting of concessions, and the dealers must be content with their previous profit of 40c. per 100 copies.

From across the water comes the news that the British Food Controller has been able to reduce the price of 13 out of 21 prime necessities. In view of the ever-increasing cost of existence in New York this is almost unbelievable. Rumors of fresh restrictions in the way of meatless days and wheatless meals are afloat, but the price of necessities has risen to an extent that the bulk of the people do not view them with any apprehension, since the time has long since passed when it was possible to afford meat on those occasions when its use was not prohibited. The new war loaf promises to be a dearer article than its predecessor, as the substitutes for wheat to be used in its composition are all higher in price than the wheat itself. A reduction of one cent per quart in the price of certain grades of delivered milk will only affect a section of the community, as the majority has adopted the 'cash and carry' plan to avoid the exorbitant cost of the delivered article.

Extensive damage is still being done by incendiaries who have been paying special attention to war materials' factories in the vicinity of New York. An interesting conclusion from primary investigations shows that these outbreaks have been caused for the most part by the radical anti-war element rather than by alien enemies. The difficulties in the way of preventing similar outbreaks in the future are therefore rendered increasingly difficult.

New York's snowfall, which shows an almost daily increment, calls for a force of about 14,000 workers per shift to effectively cope with the situation. There is a serious shortage of labor, with the result that many of the Dutch sailors from the ships now lying idle in the port are among the helpers.

TONOPAH, NEVADA

TONOPAH MINING.—TONOPAH EXTENSION.—TONOPAH BELMONT.—WEST END CON.—MACNAMARA.

The Tonopah Mining Co. shipped 20 bars of bullion, valued at $40,000. The total earnings of the Tonopah property and all the subsidiary properties for the quarter ended November 30 was $181,788. During the past week 2660 tons of ore was milled averaging $5.50 per ton. The low average value of the ore milled at Millers is due to the fact that the plant operated on ore from the old dumps. At the Silver Top 45 ft. of development has been done and 37 ft. at the Sandgrass. On the 440-ft. level of the Silver Top the cross-cut in the foot-wall of the Valley View vein is being continued. A number of stringers of good ore has been cut. On the 540-ft. level stoping has been started on the Beta Fault vein. At the Mizpah shaft on the 600-ft. level stoping has been confined to the pillars on the Mizpah vein. Work has been resumed in the north drift on the 1300-ft. level of the Sandgrass. The west drift continues in fault material and the vein has not yet been cut. Last week's production was 3850 tons.——The Tonopah Extension Mining Co. shipped 22 bars of bullion, valued at $45,000. At the No. 2 shaft 58 ft. of development has been done and 185 ft. at the Victor. At the No. 2 shaft raise No. 469 on the 1260-ft. level is in a 2-ft. face of ore. Raise No. 472 is advancing on a 2-ft. face of low-grade ore. At the Victor on the 1540-ft. level raise No. 1614 advanced 43 ft. on a face of low-grade ore. The intermediate from the 1501 winze advanced 14 ft. on 5 ft. of ore on the Murray vein. On the 1680-ft. level west drift No. 1600 advanced 31 ft. on low-grade quartz. The south cross-cut has been extended beyond the O. K. vein. The foot-wall branch of the Merger vein is called the Victor vein. The production for the past week was 2380 tons.——The Tonopah Belmont Development Co. shipped 53 bars of bullion, valued at $100,000. On the 800-ft. level raise No. 19 from the Occidental vein continues to advance on a 6-ft. face of good ore. Raise No. 20 on the same vein shows a 5-ft. face of ore. East drift No. 8021 on the Occidental vein cut a fault and a cross-cut has been started to pick up the faulted segment. On the 900-ft. level raise No. 47 has been started on the South vein exposing 2 ft. of medium-grade ore. Raise No. 48 on the branch of the Rhyolite vein shows 1½ ft. of ore. West drift No. 1146 on the Mizpah Fault vein shows 2 ft. of medium-grade ore. Last week's production was 2455 tons. The Belmont Wagner Mining Co., a subsidiary of the Tonopah Belmont, has been actively engaged on preliminary work on the mill. The mill will have a daily capacity of 300 tons and will be in operation by March 1. All the necessary office buildings and houses have been completed. The Alta properties of the Belmont company consist of 2000 acres of mineral land, near Telluride, Colorado.——At the Ohio shaft of the West End Consolidated Mining Co. drift No. 535 has been discontinued. Winze No. 534 has a total length of 100 ft. and continues in fair ore. Raise No. 528 is making fair progress in a good grade of ore. Drift No. 539 has been started. On the 555-ft. level raise No. 5 continues in low-grade ore. Cross-cuts No. 3 and 5 have been started. Raise No. 814 reached the hanging wall of the vein, and 601 drift has been started from the raise to the north to explore the vein. At the West End raise 623 No. 1 made a connection with 623 stope No. 7, and stoping has been started from the raise. The new cross-cut No. 809, which is being driven toward the Ohio territory, made good progress. The output last week was 978 tons. At the Halifax Tonopah drift No. 1019 continues on a high-grade stringer. Raise No. 1020 on the same stringer shows high-grade ore. On the 1200-ft. level cross-cut No. 1256 shows silicification. The 1708 cross-cut has been unable to advance on account of heavy ground. The production last week was 51 tons.——On the 300-ft. level of the MacNamara Mining Co. stoping is confined to the hanging wall and the foot-wall of the old stopes. On the 700-ft. level west cross-cut No. 700 advanced 25 ft. Intermediate drift No. 1 on the Ohio vein advanced 20 ft. on a 5-ft. face of ore. The production last week was 343 tons.——Good progress is being made in the new cross-cut on the 1100-ft. level of the Rescue Eula. A raise in ore from the 1050-ft. level is being driven for a connection with the 950-ft. level. ——At the Wandering Boy shaft of the Jim Butler Tonopah Mining Co. raise No. 374 on the 2nd level advanced on a 4-ft. face of ore. Repair work has necessitated slowing down development work. The output last week was 397 tons.——At the Monarch Pittsburg raise No. 815 from the 850-ft. level has reached an elevation of over 200 ft. vertically. The raise is being continued; a 650-ft. level will soon be started. The present face shows considerable quartz and conditions are such that the extension of the Ohio vein might be cut.——At the Cash Boy on the 1600-ft. level 17 ft. of ore was penetrated. Of this, 12 ft. assays $30 per ton. Work is being continued on the 1700-ft. level but a lack of cars has curtailed the output. ——The Montana produced 204 tons of ore and miscellaneous 43 tons, making the week's production at Tonopah 10,701 tons with a gross value of $181,917.

OATMAN, ARIZONA

GOLD PRODUCTION.—GOLD ORE.—TOM REED.

Oatman produced just about one-half the gold mined in the State of Arizona during 1917, according to the figures compiled by the U. S. Geological Survey. The State is credited with a total production of $4,831,000 of which the two Oatman producers contributed $2,400,000. The gold production of the State increased $900,000 during the year, Arizona being the only State in the Union to register an increase in gold output as compared with 1916. The credit of this increase is due the United Eastern, which added $1,850,000 to the State's total, there having been a considerable decrease in the amount of gold taken out by the copper mines of the State. The Tom Reed's 1917 production was approximately $550,000, an in-

crease of about $75,000 over 1916. According to the statistics compiled by the Geological Survey, Oatman's gold production was the largest ever attained by the district, being nearly three times the output of 1916, which is given as $850,000. That year was the lowest during the past decade, activities being confined to development rather than production; the Gold Road having only operated for half the year at a greatly reduced capacity. In 1915 the mines of the district produced $1,626,437 in gold, in 1914 $1,891,214, in 1913 $1,874,547, in 1912 $1,899,131. The present indications are that 1918 will register a decided increase over any previous year.——It is safe to predict an additional production from the United Eastern, as this great mine has been proucing at the rate of $2,100,000 for the last six months of 1917. The production of the Tom Reed should at least equal that of 1917, and the Gold Ore will be producing shortly. The possibilities of gold production at the Gold Road mill, now operated by the Gold Ore, are two-fold. From the Gold Ore mine a daily production of 100 to 200 tons per day is planned, and if this ore holds up to the average milling returns shown by the 2000 tons shipped to the same mill in 1916, this should mean an output in bullion of $45,000 to $90,000 per month. In order to provide a continuous supply of ore, active developments will be carried on by the Gold Ore management after production begins. The orebody opened by the original shaft 1500 ft. east from the present workings will be thoroughly explored. This old shaft is over 200 ft. deep and several hundred tons of ore was taken out of it and shipped to the Gold Road mill during its progress to that depth. There is also a strong possibility that ore from the Line Road adit workings of the Gold Road Mines Co. may be treated at the Gold Ore mill. High officials of the U. S. Smelting, Refining & Mining Co. have intimated that such was a possibility. A large body of ore running from $15 to $25 per ton is being opened by the Gold Road. While the vein is only about four to five feet wide, it is being explored by drifts in two directions and by a winze which is being sunk from the lower level. An entirely new mill to treat the ore from both the Gold Road and the Gold Ore properties is also within the range of possibilities. It is the policy of the U. S. Smelting, Refining & Mining Co. to handle custom ores, and the Gold Road Bonanza may also find an outlet for its ore here if developments place this property upon a producing basis, as present indications promise.——Oscar H. Hershey, of the Bunker Hill & Sullivan Mining Co., is now making a third exhaustive examination of the Tom Reed property with a view to future developments in the Gray Eagle and Bald Eagle sections.

Developments at the Oatman United recently have created unusual interest. The east cross-cut has opened up a vein four feet wide carrying considerable quartz and the drift along the west vein is getting into a formation showing an increased proportion of quartz showing gold. At the Record Lode, the drift along the vein to the west is opening up solid vein-matter consisting largely of quartz that assays well.

TORONTO, ONTARIO

British America Nickel—Hollinger Con.—Porcupine Crown. Kirkland Lake.—Temiskaming.

The British America Nickel Corporation has decided to abandon the proposed site of its large refinery near the Murray mine in the Sudbury district, on account of the difficulty of obtaining power. The project of developing electricity at the French river, the nearest available point, was dropped as being too costly, the revised estimates placing the cost at $46 per horse-power. The corporation will probably build the refinery at some point near Ottawa where a supply of power at a reasonable rate is assured. The construction of the smelter and the development of the mine are being energetically carried on by a working force of about 400 men. The ore-reserve is being steadily increased and is now estimated at 15,000,000 tons.——The present year promises to be one of great activity in Porcupine and the other northern Ontario gold camps. Operations at the Dome Mines, which have been suspended for some time, will be resumed shortly by the E. J. Longyear Co., which has contracted to put down No. 3 shaft to the 1500-ft. level. This company has been doing shaft sinking and exploration work in the Sudbury district for two or three years with marked success.——The Hollinger Consolidated has tried out the first



PART OF ONTARIO, SHOWING SUDBURY, COBALT, AND PORCUPINE

unit of its new equipment consisting of 20 stamps, which proved satisfactory. This will, for the present, take the place of a similar section of the old equipment, which will be closed-down, as the scarcity of labor prevents an increase in the volume of work. A greater output, however, is anticipated on account of the improvement in the grade of ore recently developed, which should increase the value of the mill-head. ——At the Vipond-North Thompson the 100-ton mill is running close to capacity, with a recovery averaging $8.50 per ton.—— The annual statement of the Porcupine Crown for 1917 shows a marked decrease in production with an output of $364,703 as compared with $575,604 in 1916. The profits for the year were $109,421 as against $270,430. The decline was caused by a cave-in at the mine during April, which hampered operations for some months. The ore-reserve is estimated at $60,000 tons, valued at $610,000.——At the Dome Lake good ore is being found in No. 3 vein in a stope from the 400-ft. level. The shaft is being put down from the 400 to the 500-ft. level.——Arrangements have been completed for the resumption of work on the

Thompson-Krist which will be carried on by the Vipond-North Thompson from the 400-ft. level of its property.

The Lake Shore of Kirkland has cut the No. 2 orebody on the 400-ft. level under the lake. The width of the vein where cut is about 22 ft. and the greater part of the ore will average about $8 per ton, with streaks carrying considerably higher gold content. The company's new mill is expected to be completed by the middle of February.——The mill of the Teck-Hughes is being overhauled and a number of improvements made to increase its capacity and improve the recovery.——At the Wright-Hargraves No. 3 shaft has reached the 200-ft. level and cross-cutting has been started. The cross-cut has passed through 16 ft. of the vein and is still in ore.——The Nipissing company is discarding the Callow oil-flotation process in favor of the cyanide treatment. Among the reasons assigned for the change are the high cost of the flotation process and the difficulty of marketing the product, which at present has to be shipped abroad for treatment. Threatened litigation over the right to use the flotation process has no doubt influenced the decision. By the use of Wilfley tables, followed by cyaniding, it is possible to produce a concentrate which can readily be turned into bullion at the company's Cobalt refinery.——The feud between the Morgenstern interests and the administration of the Temiskaming company, which has been fiercely waged for some time, appears to be decisively settled in favor of the present Temiskaming officials. A recent shareholders meeting showed that the latter held a good majority of proxy votes. Sir Henry Pellatt, a prominent Toronto financier who was expected to become president, has declined the office, but threw his influence in favor of the present board, who in all probability will be sustained at the annual meeting on February 4. ——At the Gifford a 10-in. vein showing good silver content has been cut at the 350-ft. level. The cross-cut is being run toward the Beaver to cut three intervening veins.——The annual financial statement of the Crown Reserve showed ore production of the value of $265,155, against $191,822 for the preceding year, and net profits of $82,573.——The shaft on the Violet property of the La Rose Consolidated is down 400 ft. and will be sunk 30 ft. deeper. From this point a cross-cut will be run to pick up veins which are believed to come in from the O'Brien mine.

HOUGHTON, MICHIGAN

CALUMET & HECLA.—FRANKLIN.—RAILWAY SERVICE.—ISLE ROYALE.

The discovery of the Calumet conglomerate lode, its enormous output of copper, the millions spent for labor and operations, and the millions it produced in dividends to the shareholders, has, for years, been looked upon as rarely equalled in the history of mining. It is now 15 years since the then best known publicist in the copper mining world announced that the Calumet conglomerate lode gradually was losing hold, gradually was becoming less and less an important factor in the world's copper production, and that the end of the mine was in sight. Still, owing to careful management, the Calumet conglomerate lode continues to be an enormous factor in the total output of the Calumet & Hecla copper mine, and the conglomerate lode furnishes more copper each year from the old lake sands that are being re-treated.——That the Franklin could keep alive and continue its openings and not lose money with the present high cost of mining and the control of the price at 23½c. is one of the creditable showings of the management. But Franklin not only is making a little profit right now, but it is going ahead with development work that seems to assure the future success of the mine. No. 1 shaft is down 3700 ft. All the levels run 800 ft. in each direction. The 27th and 32nd run all the way over to the expectant cut of No. 2 when it reaches that depth, namely 1600 ft. The other levels are all in good average ground. No. 2 shaft is down 50 ft. below the 17th level. No more cross-cuts will be run from this shaft, but it will be sunk straight down for a distance of 500 ft. The mine management has proved the ground at that depth. This sinking will be continued with all possible speed to cut the 27th level from No. 1. Under the unusual difficulties of a bad winter, Franklin is maintaining a production of 1150 tons of ore daily, and sometimes it runs as high as 1500 tons. This is the best average the mine has been able to keep up for any long period. Four haulage systems are working satisfactorily underground, and the intensive mining plan of having four or five drills operating in the same vicinity is working satisfactorily. A fifth haulage system is being installed. This will prevent interruption of ore shipments, as it will provide one additional haulage system for emergency purposes. Formerly when any break happened to one system there immediately came a 25% falling off in ore production. Franklin has 285 men on its force, and needs more trammers and miners. At the mill six new Wilfley tables are being installed for the re-grinding plant. A Hardinge mill has arrived, but there is little expectation of operating it for five months, owing to the difficulty of securing a motor. Franklin, perhaps the lowest-grade mine in the district, is keeping its head above water because it has the best of management and the most loyal working force ever secured at the property.——At the Mohawk shafts 4, 5, and 6 are showing a better grade of copper ore, the average for all three being 21 lb. per ton. No. 1 is in very poor quality of ore. No. 2 is still closed because of lack of labor. Motor haulage has been ordered but deliveries are not expected for months.——At White Pine Extension the north and south drifts from 2nd and 4th levels continue; the drift is in 800 ft. and south 1100 ft.; in No. 2 shaft the ore is running 25 lb. of copper per ton.——The Seneca is experiencing considerable difficulty in re-building the blacksmith and machine shops that were destroyed by fire last week. Shaft-sinking will be delayed several weeks longer.——The Osceola is producing 5000 tons daily.——If the Government of the United States wishes to learn how to handle railway service during severe storms and extreme cold weather the best place to take lessons is right here in the Michigan copper country. Practically all railway trains are completely hidden by deep banks of snow on either side of the tracks.

There is a general acknowledgment among mining men relative to the geology of the Isle Royale and its comparative formation across the lake at the Quincy and Hancock mines. The West lode, or Grand Portage, instead of being a separate formation from the Isle Royale lode proper now is looked upon as part and parcel of the main lode, simply branching from it or separated by a fault. In the Hancock Consolidated there is no doubt that the various formations which have produced and now are carrying copper are in realization all part of the same mother lode. Isle Royale mine continues to increase production steadily. The property must be operated on an enormous tonnage to make it pay decent returns to the shareholders. The company now has double the stamp-mill equipment that it formerly had, owning three of the new heads at the Point Mills plant in addition to the three heads in the main Isle Royale mill nearer the mine.——Wyandot has shipped ten cars of copper ore to the Winona mill for treatment. Six more cars likely will go this week. The ore is taken from the tenth level stope, is not selected, and to look at it one would not suppose there could be any copper in it. However, the returns from the mill are more than paying expenses and, in the meantime, the developments are encouraging.——While there are no startling evidences of betterment in Hancock Consolidated, the fact is that underground the showing is maintaining its average and the work is being laid out so that a larger ore tonnage can be established and maintained.



ALASKA

Reports come from Kuskokwim that good pay-ore has been struck on Moore creek. The defunct American Bank of Alaska, at Fairbanks, owns a number of claims on this creek; these fell into its hands for money loaned, and it is thought that the pay-streak, which was discovered on a claim adjoining the bank's property, runs through two of the claims owned by the bank.

The last of the big steel tubes for airducts to be used in the Alaska-Juneau mill for heating it with hot air are being turned out at the Treadwell machine-shops where Gilbert Walsh, the foreman of the boiler-makers, and Charles Price, of the tinsmith and plumbing departments, have been busy on the pipes and tubes for the past three months. The final sections will be completed and sent to the Alaska-Juneau within the next few days, after which the latter plant will be heated by the new process.

ARIZONA

MARICOPA COUNTY

(Special Correspondence.)—A mining deal said to involve a large sum of money is now being negotiated in the Tiptop district between S. J. Tribolet, principal owner of the Kay Mining Co., and George W. Long, one of the principal owners of the United Eastern gold mine at Oatman. The Kay mine, the property involved, is situated at Canyon station in the Black canyon on the Phoenix-Prescott road, about 45 miles north of Phoenix. It has been controlled by Mr. Tribolet for the past seven years, in which time some $75,000 has been expended in exploration and development work. There is a 350-ft. shaft and about 500 ft. of drifts. On the 350-ft. level the vein, which is narrow on the surface, has widened to 25 ft. of commercial sulphide ore. Smelter returns from 32 cars of ore shipped by the Tribolet interests show an average of 10 to 12% copper.

Phoenix, January 27.

PIMA COUNTY

(Special Correspondence.)—The exploration shaft of the Silver Queen group of mines, recently leased from William J. Bryan Jr., has penetrated an orebody on the 100-ft. level reported to assay 700 oz. silver per ton and 20% copper. The shaft will be continued to the 200-ft. level and drifts will be run at the 100-ft. level. H. S. Emlaw is supervising the work while William J. Bryan Jr. is in actual charge of the property.

Tucson, January 25.

CALIFORNIA

AMADOR COUNTY

(Special Correspondence.)—The South Eureka Mining Co. will discontinue operations at both the South Eureka and Oneida mines during the present week, as a result of lack of ore in paying quantities and the unwillingness of stockholders to spend more money in prospecting for better ore to mix with the large reserve of low-grade material in sight. Under the terms of the pumping agreement existing between the South Eureka Mining Co. and the Central Eureka Mining Co., the latter will doubtless be called upon to shoulder the expense of keeping the two mines unwatered. The two shafts are connected by means of long drifts and the one pumping system in the South Eureka shaft handles the water from the Central Eureka as well as the South Eureka mine. The Central Eureka Mining Co. has paid its proportion of expense in operating this system since it was started and, for the protection of its property, may now have to shoulder the entire expense. This increase in operating expense at the Central Eureka mine, which is being operated on an assessment basis, is discouraging at this time, but recent improvement in the grade of the ore mined may enable the company to meet the demand. The plant is in better shape than for many years and 30 stamps of the 40-stamp mill are dropping steadily on ore that practically meets present expenses.——Since completing the enlarging of the Old Eureka shaft from the 1600 to the 2165-ft. point, sinking has been steadily in progress, an average of 17 to 20 ft. being made each week. The intention is to extend the shaft 1000 ft. below its former bottom before beginning extensive horizontal development.

Sutter Creek, January 28.

The Kennedy copper mine in the Buckskin mountains near Yerington is rapidly developing large orebodies averaging 3% copper and $6 to $8 in gold. The company is now driving under the hill at a depth of about 250 ft. and has an ore-shoot open for a distance of 400 ft., with the end not yet in sight. This is at a point 300 ft. west of the shaft, and the ore found is all of a milling grade averaging $18 to $20 per ton. Over 40,000 tons of this mineral is now blocked out and it is probable that with the advent of spring the company will turn its attention to the erection of a flotation plant.

ELDORADO COUNTY

(Special Correspondence.)—Active development work is in progress on the Red Wing quartz mine, situated half a mile south-west of the Martinez Gold mine and three miles south of El Dorado railroad station. The vein has been uncovered at the 200-ft. level by a 300-ft. cross-cut. Several strata of genuine 'Mother Lode' quartz have been cut, from 3 to 14 inches wide, which assay $15 in gold per ton. The adit is being extended across the vein to the foot-wall. After the foot-wall is reached, drifts will be extended north and south and a winze sunk on the vein. Seth G. Beach and his son Joe, of Placerville, have recently acquired a large interest in the Red Wing mine.——A recent clean-up of the first mill-run of the wide friable porphyry-ore dike on the Cincinnati mine, eleven miles north-west of Placerville, yielded an average of $3.82 gold per ton on the plates. The amount and assay of the concentrate have not been determined. The total cost of mining and milling the ore was less than one dollar per ton. The California Porphyry Gold Dike property, an east extension of the Cincinnati dike, will, it is understood, soon be developed on a large scale by New York capital.——The Aluminum Gold quartz mine, three miles south of Placerville, is being operated under a working-lease by Andrew Anderson. The Aluminum mine has a true fissure-vein of high-grade quartz, from which considerable gold has been recovered in the past.

Placerville, February 1.

NEVADA COUNTY

(Special Correspondence.)—The Grass Valley Consolidated Co. has re-organized the staff of the Allison Ranch mine.

William Harvey is superintendent; Frank R. Hull, assistant superintendent; and E. C. Uren, consulting engineer. Mr. Hull was formerly assistant superintendent of the Empire mine, and Mr. Uren for many years has been a prominent engineer of this field. It is officially announced that ore of milling grade is being mined on the second, third, and sixth levels, and that the new vein is developing splendidly. Lessees are active at a number of points and several have engaged additional miners to expedite work. Some of the lessees are reported to be averaging $25 to $45 per day net. Unwatering of the shaft below the 700-ft. level is making good progress.——The North Star Mines Co. is completing a restraining dam to prevent flow of mill-tailing into Wolf creek. The Golden Center, Allison Ranch, and other companies are also arranging to prevent discharge of debris into the creek. For 65 years debris has been discharged by local companies into the stream, which drains into the Sacramento river, but an order was recently issued by the California Debris Commission prohibiting the practice. ——A heavy output of chrome is being made from properties at Lime Kiln. Eight motor-trucks are engaged in transporting the ore to the Oustomah mill at Nevada City, and the resultant concentrate is shipped to Eastern steel mills. The deposits are proving extensive, with much of the ore high-grade. Prospecting for chrome is active along Deer creek and promising deposits have been uncovered.——Favorable weather has enabled the Washington Asbestos Co. to work its asbestos claims, near Washington, all winter, and the mill will be placed in operation shortly. It is stated that much profitable mineral has been placed in sight in the past three months. Oakland people are principally interested.

Grass Valley, February 4.

SHASTA COUNTY

(Special Correspondence.)—The electrolytic plant at the Kennett smelters employs 75 men and is now turning out three tons of zinc per day. In addition to this 200 lb. of cadmium is recovered. Cadmium, which is worth $165 per pound, is valuable as the base for automobile paint.

Redding, February 2.

TUOLUMNE COUNTY

The Pacific Coast Mines Corporation, controlled by W. J. Loring and powerful Eastern financiers, has acquired title to the Dutch, Sweeney, and App mines in this county, and is preparing for operations on a large scale. The mines have been undergoing extensive development for several years, and are considered among the best gold properties on the Mother Lode. High-grade milling ore was opened last summer in the new deep levels of the Dutch shaft, and effective methods for treating the sulphide ore has been discovered. The present plans include the erection of a mill of 700 or 800 tons daily capacity, with a probability that flotation will be used extensively.—— The Pacific Gold Dredging Co. has established an excellent camp near Auburn, and is rapidly re-constructing the steel dredge that was formerly operated on the middle fork of the American river. An extensive area of dredging ground has been established on the north fork of the river, where the boat will operate in future.

COLORADO

BOULDER COUNTY

The Degge-Clark Tungsten Mining, Milling & Refining Co. has been re-organized and has changed its name to the Caribou Metal Co. The new company will have a capital of $2,000,000. The Caribou silver mines have been acquired, together with several adjacent mines, and hoisting and compressor plants have been ordered. During the 'seventies and early 'eighties these mines produced several million ounces of silver, and on the dumps and in the stopes are large quantities of ore that was considered to be waste at that time.

LAKE COUNTY

A body of manganiferous iron ore, carrying 44 oz. silver per ton, has been struck at a depth of 87 ft. in a shaft at the Dunkin property on Fryer hill. A steam-hoist has been placed at the shaft and the sinking will be continued until the body of ore is penetrated when levels will be driven. The shaft has already passed through 12 ft. of ore.

TELLER COUNTY

(Special Correspondence.)—The Roosevelt tunnel of the Cripple Creek Deep Drainage & Tunnel Co., during the past week, entered the Portland Gold Mining Co.'s Colorado City lode-mining claim on the north-eastern slope of Battle mountain, and its course has now been diverted south-east to a point directly under the Portland No. 2, or main shaft. At this point the tunnel will have a depth of 2130 ft.; the station to be cut there will have an elevation of 8114 ft. above sea-level and will be 26,000 ft. from the portal. While still in Rose Nicol territory, a station was made where the tunnel cross-cuts the Hidden Treasure vein of the Portland system. At this point the ore ranged from $3 to $16 per ton. The Camp Bird Mining, Leasing & Power Co., holding a six-year lease on the properties of the Rose Nicol Gold Mining Co., will start driving from the adit-level on this vein.——Lee Martin, lessee on the Kitty M., one of the Gold Hill properties of the Mary McKinney Mining Co., has opened up a five-foot vein of milling-grade ore and has commenced shipping.——The Granite Gold Mining Co. on Battle mountain and lessees are shipping heavily and the January production will be close to 3000 tons. The value will hold to an average of $20 per ton.——J. C. Ferrill, assessor of this county, and chairman of the Mines and Mineral Lands Committee of the Colorado County Assessors Association, has advocated a valuation on non-producing mining claims, lode or placer, of a sum not to exceed $60 per acre. The matter was under consideration at the recent meeting of the State assessors and the valuation will be recommended.

Cripple Creek, January 31.

MONTANA

SILVER BOW COUNTY

Concreting of the Granite Mountain shaft of the North Butte Mining Co. has been completed and the cages are in operation to its lowest level. Power cables are being lowered, bells connected, and the finishing touches given to the repairing of the shaft, which was put out of commission by fire last June. The four-compartment shaft has been lined with steel beams, buried in heavily reinforced concrete down to the 3000-ft. level, below which the shaft is wet and therefore considered fireproof. With the Granite shaft in commission again, it is expected that the North Butte will soon regain its normal ore production of 1700 tons daily. The company has been lifting around 600 tons daily through the Speculator shaft for the past month.

NEVADA

CLARK COUNTY

(Special Correspondence.)—The Yellow Pine Mining Co. has arranged to use a Herman ball-mill for grinding of the middling from the concentrators; the re-ground product will be re-treated on another set of tables to effect a closer extraction. Additional rolls have been placed in commission and a new Fairbanks-Morse gas engine has been purchased. On the north end of the 700-ft. level the main orebody continues to develop splendidly; it was opened by a cross-cut 1100 ft. long. Another cross-cut has been advanced 950 ft. from the 900-ft. level and is expected to tap the vein in about 200 ft. Promising veins are also receiving attention on the 300 and 600-ft. levels in the south end of the property. The ore contains lead and zinc.—— George Roth and associates have taken leases on the Mountain Boy and Mountain Girl claims of the Christmas Consolidated.

——The Hoodoo mine has been leased to D. T. Duncan and Frank Williams for five years by the Kansas-Nebraska Mining Co. Some good ore was recently uncovered, and the new operators are arranging for deeper development.——High-grade zinc and lead ore is being shipped from the Milford group, operated by the Goodsprings Mining Co. The group includes the Milford and Addison claims, near State Line Pass, on the California-Nevada boundary line. The company was formed by Jesse Knight and C. L. Hyde in 1910. E. J. Delano is superintendent.

Goodsprings, February 2.

HUMBOLDT COUNTY

(Special Correspondence.)—The National Mines Co. is preparing for resumption of extensive work at its holdings in the National district. The lease held by the National Leasing Co., headed by George Graham Rice, has been canceled, following the failure of the leasing company to pay its rental for January, amounting to $2400.——The National Nevada Mining Co. has resumed driving of the lower adit with the view to cutting the orebody exposed in the upper level. N. P. R. Hatch is manager.

Winnemucca, February 2.

MINERAL COUNTY

(Special Correspondence.)—Harry B. Lind, controlling owner, has resumed operations on the Iroquois Copper on company account. The mine has been working steadily but for several months the activity was confined to lessees, who have been shipping an excellent grade of ore. The main adit on the Mastodon is being put in order, but Mr. Lind has not decided whether to continue it ahead or to put up a raise from its face to open up the orebodies which were 'glory-holed' near the surface. It is the intention to throw open a greater portion of the Iroquois ground to lessees, as Mr. Lind estimates that, without interfering with company work, there is room for 25 sets, many of whom can begin work on a commercial grade of ore.——The north-west drift on the Calavada is entering a promising country on a contact between black lime and monzonite. Between these is an oxidized vein, two feet wide, carrying considerable red oxide of copper, which, where it penetrates into the lime, changes to carbonate of copper. Work has been resumed on the south-east drift.

At the Copper Ridge, two miles east of the Calavada, a winze is being sunk from the 260-ft. level where the big 24-ft. vein contains an orebody 10 ft. wide which averages 10% copper and from which many large specimens of rich chalcocite and oxide ores have been taken. George Giroux is the owner.

There has been a cave-in at Stockham adit No. 2 of the Luning-Idaho company and progress has been delayed until it can be timbered. This adit is going out to tap at depth a good orebody which cropped to the surface and which was opened in No. 1 adit.

Luning, January 29.

STOREY COUNTY

Mining operations at the north end of the Comstock lode continue to give satisfactory results, with Union Con. maintaining average shipments in tonnage and grade of ore. The stopes continue to yield well on the 2400-ft. level, and some high-class ore is being taken out in the advance of the north drift from the 2500-ft. level raise. From the last record at this point the ore broken down averaged better than $60 per ton. A feature of the week has been the shipment of six bars of bullion from the Mexican mill, the value of which was in excess of $23,000. The Sierra Nevada has completed the work of placing air-pipe and other equipment on the 2500-ft. level to the vein exposed in the north-east drift from the east crosscut, and work in the vein will be started at once. Elsewhere in the north end, conditions remain favorable; the Ophir company is shipping ore extracted from the 2100-ft. level to the Mexican mill. The ore from this level last week averaged $18 per ton for 147 cars. The Montana company is driving ahead its exploration work as usual and the Con. Virginia continues development work on the 2700-ft. level.

The Jacket Con. is taking out much ore from the adit-level workings in Gold hill, and is operating part of its mill. Work also continues on the new equipment. Three bars of bullion were shipped last week.

It is understood that the Christmas Mining Co. has granted a lease covering all its holdings in the Gold Hill district to local parties and that operations are to be started on an extensive scale before March 1. The holdings of the company are classed as among the most promising in the district, as there are extensive surface showings of high-grade ore, while a shoot of silver-lead ore opened in the deepest shaft has been productive of ore carrying up to 360 oz. silver per ton. The holdings of the company consist of twelve patented claims, covering 246 acres, the last patents having been received May 1, 1913. The property is situated about three miles due east from Gold Hill and only two and one-half miles from the Deep Creek railroad, forming a solid group of rectangular shape approximately 7200 ft. long and 1800 ft. wide. While no special effort is being made by the Woodman Mining Co. to develop the tungsten deposits of the Frankie mine, the production of scheelite ore is being continued and several tons of high-grade ore have been accumulated. Some of the ore is extracted in chunks of good size which do not contain much waste, though, because of the tendency of the ore to pulverize easily, a good deal of the fine cannot be saved, but goes into the bins with copper ore.

WHITE PINE COUNTY

J. H. Goodman of McGill last week brought 450 lb. of ore from a recent strike made in the property of the Willow Creek Gold Mining Co., which was worth several dollars per pound in gold. The ore was shipped to San Francisco by express, Mr. Goodman placing a value on the shipment of $2500. The new strike was made on the 160-ft. adit-level, the pay-streak being four feet wide, about eight inches of which is exceedingly rich in gold. Assays from the remainder of the vein run from $600 to $800 per ton. When Mr. Goodman left the mines last week the vein had been driven on for a distace of seven feet, the grade of the ore holding good for that distance, but of course the development was not sufficient to guarantee permanency.

NEW MEXICO

SOCORRO COUNTY

(Special Correspondence.)—The Mogollon Mines Co. produced 11,000 oz. gold and silver for the first half of January



MAP SHOWING SITUATION OF MOGOLLON

besides concentrate; 150 tons of ore is being put through the mill daily.——The Oaks Co. has commenced work on its Cen-

tral shaft. Two shifts are at work. Development and production continues from Maud S., Deep Down, Clifton, Eberle, and Pacific mines, which are being operated by this company. ——The Socorro Mining & Milling Co. is making good headway with its new mill. An effort is being made to have the mill in operation by May 1. Development is being continued underground and the broken ore-reserve is being increased. Hoisting will be started as soon as the head-frame is complete.——The district is again abundantly supplied with water after a long dry spell.

Mogollon, February 2.

OKLAHOMA

OTTAWA COUNTY

The Federal Lead & Zinc Co., owning leases in the North Century field, has just closed a contract for the erection of one modern 300-ton plant on one of its tracts. Two leases, one of 20 acres and the other 40, have been thoroughly developed, with some of the drill-cuttings reported to have shown as high as 50% ore. The mill, for which a contract has just been let, is to be erected on a blocked-out site on the 20-acre lease. Steam will be used for power in the first plant, according to the plans and details. Three 150-hp. high-pressure boilers have been ordered. A 150-hp. Corliss engine will be used. Henry M. Martin of Miami has been awarded the contract to build the mill. The plans and specifications show that it will cost around $85,000. Hubert L. Bolen is president; J. P. Whatley, vice-president; Verne Thompson, secretary and manager; and A. M. Brannon, treasurer.——An excellent deposit of ore has been developed on a lease of the Southeastern Missouri Mining Co. situated between Picher, Oklahoma, and Treece, Kansas. Of the 31 completed holes on the tract a majority of them have shown ore at almost a uniform depth. The company has 40 acres in all, with a shaft already started and plans completed to erect a mill of 500 or 600 tons capacity.

OREGON

JACKSON COUNTY

(Special Correspondence.)—The Gold Hill Manganese Co. has been incorporated with a capital of $1,000,000 and headquarters at Grants Pass. The property is known as the Manganese Consolidated, was located in 1909, and recently sold by McCallister & Britten to L. F. McConiche of Tacoma. It consists of four claims on Shan creek, six miles from Rogue river. Recent assays show 24 to 44% manganese, with gold-bearing quartz running as high as $724 per ton. The mine will be equipped with jigs, water motor, crushers, rolls, sawmill, and stamp-mill, and $5000 will be spent on the road leading to the mine.

Gold Hill, January 30.

(Special Correspondence.)—Allen Davis and W. A. Patrick, of Ashland, are developing a chrome deposit 10 miles west of that city. Talent is the nearest shipping point with a down-grade haul.——Croppings of asphaltum and dried oil, which can be traced for half a mile, have been uncovered on government land six miles east of Ashland. M. G. Womack of Medford, associated with men of that city, and H. J. Barton, of California, have located claims on the deposits. The ground will be explored at once to determine the advisability of exploiting for oil by drilling.

Gold Hill, January 31.

CANADA

BRITISH COLUMBIA

Nickeliferous pyrrhotite has been discovered at Barkly sound, Vancouver island, by A. L. Smith, of Alberni. Samples assayed at the provincial assay office at Victoria averaged 1.5% nickel, while those sent to the laboratory of the Department of Mines at Ottawa assayed 2.5% nickel.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Charles Janin is in New York.

W. J. Hamilton has gone to Peru.

Albert Burch has gone to Washington.

S. Herbert Williams is here from Ely.

F. E. Graham Berry has returned to Seattle from Amador, California.

O. D. Welsch has gone to Tonopah after a short visit in San Francisco.

O. B. Perry has been promoted to Lieutenant-Colonel in the Engineer Corps.

J. Power Hutchins is now in New York, his office being at 120 Broadway.

James P. Gaskill has opened an office in the Security building at Los Angeles.

Ira B. Joralemon is Captain in the Signal Corps of the U. S. Army in France.

Morton Webber was in New York on a hurried visit and left again for the West.

Carlos W. Van Law has left Boston on a trip westward, including British Columbia.

A. N. Talbot has been elected president of the American Society of Civil Engineers.

Hugh R. Van Wagenen, now resident at Pioche, Nevada, has been in San Francisco.

Spencer Bishop has been appointed chief mechanical engineer to the Arizona Copper Co. at Clifton.

Wheeler O. North has been appointed assistant to the general superintendent of the United Great Eastern Mining Co., at Oatman, Arizona.

A. H. Higgins, a distinguished member of the Minerals Separation staff, has arrived in San Francisco to prepare for the hearing of the Butte & Superior case.

J. Parke Channing has taken over the duties, as consulting engineer to the Utah Consolidated Mining Co., of his brother R. H. Channing, who has volunteered for military service.

The Income Tax and Other Federal Taxes. By Joseph J. Scott. 300 pp., with appendix 50 pp. and index 20 pp. San Francisco, 1917. For sale by Mining and Scientific Press. Price, $2.

Joseph J. Scott was formerly Collector of Internal Revenue at San Francisco, and his book contains instructions in the simplest and plainest langauge to determine the exacting requirements of the present United States tax laws. The technicalities of legal langauge have been discarded and in plain words the taxpayer is told precisely what he can do and what he must do. The farmer's problems are treated in detail so that every farmer can tell what to do. In the past the farmer, as a rule, has experienced a great deal of difficulty in complying with the income tax law. Under the new laws his difficulties are multiplied. Practically every farmer, merchant, tradesman, professional man, and salaried man, and a great many wage-earners, will be required to make reports and to pay tax. It will be necessary for the taxpayer to be correctly informed as to his rights before he is called upon by the Government officer to make his report. He must know how to claim all his allowable deductions; otherwise, he may overpay his tax hundreds of dollars. With the exemption lowered to $1000 in the case of single persons and $2000 for married persons, thousands who have never paid income tax must do so this year. This book answers the questions that arise under the income or excess profits tax-laws.

THE METAL MARKET



METAL PRICES

San Francisco, February 5

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.95
Antimony, cents per pound	16.00
Antimony (wholesale), cents per pound	14.25
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67½
Pig-lead, cents per pound	7.00— 8.00
Platinum, soft and hard metal, respectively, per ounce	108— 116
Quicksilver, per flask of 75 lb	$125
Spelter, cents per pound	10.00
Zinc-dust, cents per pound	20.00

A tentative price of $90 per oz. has been set by the Government for the purchase of 21,000 oz. of platinum recently imported from Russia. Bankers in Petrograd who financed the collection of the metal will be allowed to produce proof of the expense incurred if they think a higher payment should be made.

ORE PRICES

San Francisco, February 5

Antimony, 45% metal, per unit	$1.00
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.70— 0.85
Magnesite, crude, per ton	$8.00—10.00

There is little demand for either calcined or crude magnesite.

Manganese: The Eastern manganese market continues fairly strong with $1 per unit Mn quoted on the basis of 48% material.

Tungsten, 60% WO_3, per unit	26.00

Tungsten ore remains firm.

Molybdenite, per unit MoS_2	$40.00—45.00

EASTERN METAL MARKET

(By wire from New York)

February 5.—Copper is quiet and unchanged at 23.50c. all week. Lead is inactive and firm at 7c. all week. Zinc is dull and unchanged at 7.87c. all week. Platinum is unchanged at $108 for soft metal and $116 for hard.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Jan. 30	86.62	Dec. 25	86.42
" 31	86.62	Jan. 1	86.62
Feb. 1	86.62	" 8	88.66
" 2	86.62	" 15	90.04
" 3 Sunday		" 22	89.29
" 4 Holiday		" 29	87.35
" 5	86.62	Feb. 5	86.62

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	....	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

Samuel Montagu & Co. says: A feature of the general monetary situation in Hongkong and South China is the extraordinary exchange value of gold, which has resulted from the prohibition of exports of the metal from various warring nations, and particularly from the United States and Japan. Current exchange-bureau rates in Hongkong today are $5 in American paper for $4 American gold coin—a premium of 25% for the metal over its equivalent in a monetary medium that is equally current at par in the United States or over corresponding bank exchange. There is a fair demand for silver for the purposes of trade, fortunately sufficient supplies have been forthcoming for the last few days without the price being affected. The Shanghai exchange has been firm at the official quotation of 4s.5d. per tael.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Jan. 30	23.50	Dec. 25	23.50
" 31	23.50	Jan. 1	23.50
Feb. 1	23.50	" 8	23.50
" 2	23.50	" 15	23.50
" 3 Sunday		" 22	23.50
" 4 Holiday		" 29	23.50
" 5	23.50	Feb. 5	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	....	Aug.	27.03	27.42	....
Mch.	26.65	36.00	....	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Magnesite is offered freely at prices ranging from $35 to $36 per short ton, f.o.b. shipping point, for high-grade calcined material. Very little business, however, is reported.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Jan. 30	7.87	Dec. 25	7.75
" 31	7.87	Jan. 1	7.87
Feb. 1	7.87	" 8	7.87
" 2	7.87	" 15	7.87
" 3 Sunday		" 22	7.87
" 4 Holiday		" 29	7.87
" 5	7.87	Feb. 5	7.87

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	....	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Jan. 30	7.00	Dec. 25	6.46
" 31	7.00	Jan. 1	6.50
Feb. 1	7.00	" 8	6.65
" 2	7.00	" 15	6.75
" 3 Sunday		" 22	6.98
" 4 Holiday		" 29	7.00
" 5	7.00	Feb. 5	7.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	....	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending

Jan. 8	130.00	Jan. 22	125.00
" 15	130.00	" 29	125.00
		Feb. 5	125.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	....	Aug.	74.50	115.00	....
Mch.	219.00	113.75	....	Sept.	75.00	112.00	....
Apr.	141.60	114.50	....	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	....	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

ORES

Molybdenum and antimony: There is no change in the range of quotations for molybdenite, which is $2.15 to $2.20 per lb. of MoS_2 in 90% material. Canadian concentrates are being offered more freely. The antimony ore market is inactive in New York.

Manganese ore: Quotations for both foreign and domestic high-grade ore range from $1 to $1.30 per unit. The Brazilian government has declined to bring any more ore down from the mines on its Central Railway because of lack of coal, and manufacturers in this country have been notified to send no ships to bring ore already contracted for. Sixty days is reported as the time set for the idleness of the road.

Ferro-chrome: Offers have been made in this market at 35c. per lb. for contained chromium for certain grades.

Charles Hardy says: A fair business has been done during the past week in tungsten ores, especially in wolframite, and prices ranging from $26 for the highest grade to $20 for off-grade ore have been realized. The business, however, is much handicapped by railroad embargoes, not only here for shipments West but also from the West Coast for shipment East, and it has been practically impossible to sell any Californian scheelite for this reason, as buyers do not know when purchases now made will be likely to reach the East. Nominally scheelite is held by the biggest producer at $30 per unit, but business in spot lots has been done at a heavy discount.

Chrome continues scare and people are asking as high as $1.75 per unit for 45 to 47% material landed New York. Sales have been reported made at $1.55 per unit, but none have been confirmed at the higher figure.

Eastern Metal Market

New York, January 31.

Monday was fuelless, workless, and lightless day in this town, and practically no business in metals was done. The market has been mostly quiet the past week except in copper.

Copper has been quite active at the Government prices.

Spot tin is as scarce as ever at nominal prices.

Lead is very dull, but decidedly firm.

Zinc is very quiet at unchanged levels.

Antimony is lifeless at the same prices as a week ago.

Snow, cold, and floods, alternately have continued to interfere with steel and pig-iron output east of the Mississippi. Chicago is but slowly recovering from almost a complete shutdown. War shipments constitute about 75% of the current movement in the heavier finished steel lines. The supply of low-phosphorous pig-iron is not regarded as sufficient to make enough acid steel for gun-forgings required by the Government. The anouncement that Brazil has practically shut off manganese-ore supplies for 60 days is a source of considerable comment now and some anxiety. The refusal is due to lack of coal to operate railroads in that country. This, coupled with the facts that our imports of ferro-manganese and the domestic output have declined decidedly recently, is not reassuring.

COPPER

Producers have been selling copper freely at the Government price of 23.50c. since the announcement, noted in our letter last week, that the price would remain in force until June 1. This decision steadied the entire market. The sales made have been for delivery until that date, and have included all consumers, both the Government and individuals, with the usual restrictions, as a matter of course. There is not much spot copper available, due largely to the fact that arrivals of ore at the refineries, most of which are in the East, have been delayed because of the railroad congestion. The belief continues, however, that the supply will be ample for the coming months. The movement into consumption is known to be enormous. This adjective also applies to the exports, which have been on an exceedingly large scale. Estimating the December outgo at 35,000 tons, the total for 1917 will be 484,123, as compared with 327,310 tons in 1916, with 276,344 tons in 1915, with 360,229 tons in 1914, and with 382,810 tons in 1913, which was the banner year before the War. Imports have been large. For 1917 the estimate is 239,000 tons, against 199,000 tons in 1916, and 137,500 tons in 1915.

TIN

The feature of the week was the commandeering for the second time by the Government of tin in storage warehouses. This took place on January 23, and was for the needs of the Army, the previous occurrence, some weeks ago, having been for the Navy. Some surprise is expressed that this should be possible without the knowledge, or at least without the instrumentality, of the Tin Committee of the American Iron and Steel Institute. It is understood that some of the tin, seized in that manner last week, has been released to the regular consumers to whom it belonged. Importers are having a world of trouble, and the complaint is general that there is no pleasure in doing business. The tin situation in New York is really bad. If a dealer or importer is able to get it across the ocean and into port he encounters difficulty at once in shipping it to the interior because of railroad embargoes. If he leaves it on the dock beyond a prescribed time, the steamship company consigns it to a storage warehouse. If the metal is brought overland, there loom up losses due to demurrage and to railroad delays. If the metal finds a lodging in warehouses, it is commandeered by the Government, and so it goes. The importer is 'getting it' from all directions and consumers are clamoring for tin that they urgently need. Quiet pervades the market in general. Spot tin is unobtainable, but is nominal at 85 to 86c. per lb., New York, with sales reported of small lots of a ton or so at 90c. to $1 per lb. There has been a little business in futures, but the demand has not been widespread. Last Saturday a little business was done in far-off future tin, very quietly put through. Yesterday, sales of March-April shipment from the East were reported. Arrivals up to yesterday inclusive were 1720 tons, with 5300 tons reported afloat. The London market is lower. Spot Straits yesterday was quoted at £299 10s. per ton, as compared with £302 a week ago.

LEAD

Quotations are unchanged from last week at 6.85c., St. Louis, or 7c., New York, in the outside market, with the American Smelting & Refining Co. asking 6.75c., New York. The market is still at a dead stop, with transportation the controlling factor. Arrivals from the West are much delayed. There is plenty of metal in cars, but at refineries, and in the markets, it is getting scarce. The leading producer is reported as taking no February business, but as accepting March orders at its quotation. Spot lead is higher, according to reports to the effect that spot metal has sold in the last few days a 7.37½c., New York, with retail lots at 7.75 cents.

ZINC

Considerable has been heard lately about a 40% contraction in the zinc output of the country. This is probably true, but the effect is now being offset or neutralized by a decided lessening in exports, leaving more metal available for the market. While the export demand is still large, facilities to ship it are contracting because vessels are being urgently pressed into other service. The market continues dull and uninteresting, with demand at a low ebb. Business continues of the small-lot order at the levels which have prevailed now for nearly two months, or 7.62½ to 7.75c., St. Louis, or 7.87½ to 8c., New York, for prime Western for early delivery. Spot metal has sold at 8c., New York, recently. The market does not go up because of lack of demand, and it cannot go much if any lower because it is regarded as now at rock bottom. Evidence of this is contained in the fact that representatives of Western mining interests recently met in Washington and notified the Government that there was no profit in their business with zinc at less than 10c. per lb. They are reported to have asked for a fixed price at this level.

ANTIMONY

There has been no change in the last week. Quiet pervades the market, which is quoted at 14c. to 14.25c. per lb., New York, duty paid, for Chinese and Japanese grades for spot and early delivery.

ALUMINUM

The market is without life for spot and early delivery and is quoted at 36 to 38c. per lb., New York, for No. 1 virgin metal, 98 to 99% pure.

ORES

Tungsten: The market is quiet at the regular quotation of $24 to $26 per unit in 60% concentrate, with scheelite commanding the higher price. Transactions are reported in moderate volume. Ferro-tungsten is unchanged at $2.35 per lb. of contained tungsten.

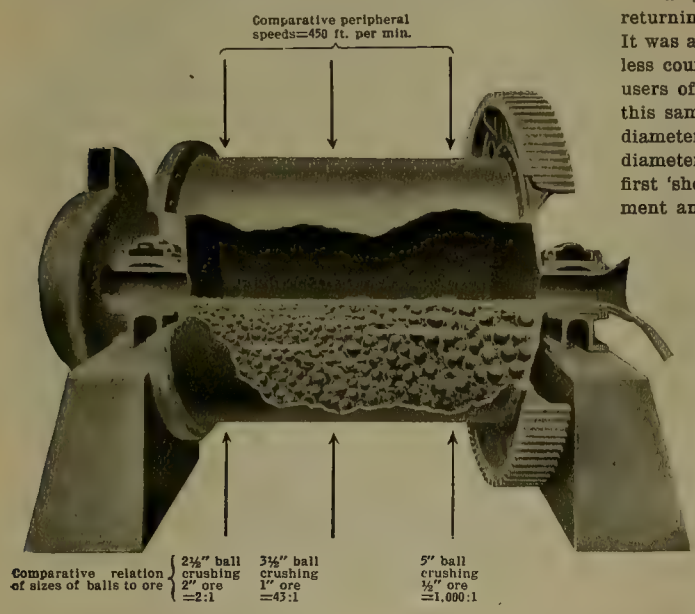
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

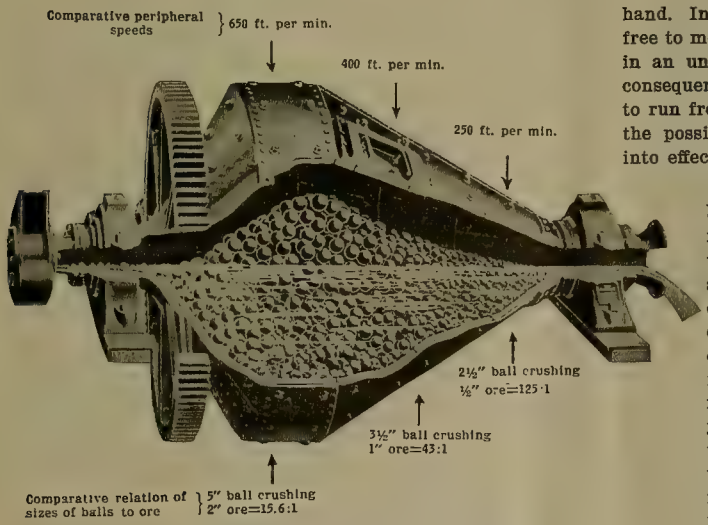
WET AND DRY-CRUSHING BALL-MILLS

By H. W. HARDINGE

DEVELOPMENT OF THE CONICAL MILL. In the following I may plead guilty to plagiarizing certain lines which have appeared in previous articles on ball-mills, with which both observation and practice do not in any way coincide, but a free and open discussion may be of benefit to the engineer who desires to arrive at an independent conclusion from different standpoints.



ARRANGEMENT OF BALLS IN A BALL-MILL



ARRANGEMENT OF BALLS IN A HARDINGE MILL

The first ball-mill that I used was nearly 15 years ago. It was a cylindrical peripheral discharge mill, with a device for returning the over-size back into the same mill for re-crushing. It was ascertained that this mixing of coarse and fine more or less counteracted effective work, but, like some of the present users of ball-mills, I was obliged to use the mill at hand. In this same plant I also installed a cylindrical pebble mill 6 ft. diameter by 8 ft. long, instead of the still older style, 50 ft. diameter by 20 ft. long. The 6 by 8-ft. mill was perhaps the first 'short mill,' and its operation showed a general improvement and efficiency over the longer mill with which previous experience had been gained; it did practically the same work as the longer mill, requiring only power proportionate to its length. My next experiment, based on the 6 by 8-ft. mill, was to construct one 6 ft. diam. by 6 ft. long, which later was lined with plates, forming a cone, within the cylinder. This first conical mill did practically the same amount of work as the 6 by 6-ft. cylindrical mill, and consumed only about 50% as much power. This experiment has since been duplicated by hundreds of other conical mills in operation in different parts of the world.

At the time this change was made from a cylindrical to a conical mill, I realized that the ball and charge thrust against the end-walls of the former cylindrical mill caused the excess power consumption, increasing the wear and tear. An impinging of the grinding-load against the ends of the mill caused excessive wear not only of the grinding media but of the end-plates, a repair stock of end-plates being kept on hand. In the mill fitted with the conical bottom the balls were free to move up an incline and return to the centre of the mill in an unobstructed flow, thus practically removing a brake, consequently reducing the power needed, allowing the vehicle to run free and smooth and still to accomplish nearly 100% of the possible work, converting the energy of wear and tear into effective reduction of the ore.

SPEED OF THE MILLS. Referring to recent articles by Mr. Stout, also to one by another experimenter relative to the proper speed of ball-mills, both of these relate to the ordinary ball-charge contained in a ball-mill, which balls we know vary from 2 to 5 in. diameter. Mr. Stout seems to have overlooked the crucial point that the conical mill has a multiplicity of peripheral speeds, as indicated in the accompanying illustration. One article says: "I assume that the mills (cylindrical) are operated at the proper speed, just under that producing centrifugal cling, and that the pulp is of the proper consistence." This assumption is not based upon physical laws or actual work in a ball-mill. I contend that it is a practical impossibility to operate any cylindrical mill, at a totally effective speed, when loaded with a general assort-

ment of different sizes of grinding-media, as must necessarily be done if the balls are not discarded as soon as slightly worn. If it had been stated that each size of ball has a critical speed-limit which should come just within the limit of 'centrifugal cling' it would have presented a lay in physics and practice which is unalterable. The assumption is equivalent to stating that projectiles of different calibres and weights will be translated the same distance with the same powder-force behind it, for the peripheral speed (projectile force) of a cylindrical mill remains the same throughout its length. As boys, when we knew that the farmer's gun was loaded with half an ounce of powder and an ounce of birdshot, we also knew that we were safe at a distance of 100 yards, but when we learned that the same gun had been loaded with an ounce of buckshot and the same amount of projectile force (powder), we allowed a distance of 300 yards as being necessary for safety.

There is no 'critical speed' for a cylindrical mill containing a charge of assorted sized balls, for, if the mill is operating at the critical speed for a 4-in. ball it is altogether too fast for a 2-in. ball, and if a critical speed for the 2-in. ball is being maintained the noise made by the pounding of the 4-in. ball will demonstrate that there is excessive wear and tear on both lining and balls, which will be confirmed by shut-downs for repairs. Further confirmation of these physical laws is easily obtained by referring to any text-book, provided we have overlooked our boyhood experience, if not with the farmer in the summer time, at least in the winter sport of snow-balling, when we were careful to make the exact size of snowball that would reach the object aimed at. The following cut. Fig. 2, drawn from actual condition found by examination to exist in tubular (cylindrical) mill, with removable end, is not a supposition but a fact. It will be noted that the large balls have found their natural working place among the finely ground material at the bottom of the pulp and at the point of least resistance at the discharge-end of the mill, that is, against the head, while the smaller balls remain at the feed-end of mill among the incoming coarse feed, where the work they perform is comparatively nil. In both instances the position of the balls follow natural laws of gravity.

There is, of course, a material difference between crushing wet and dry. The conical mill in its first commercial stage was used as a dry crusher in reducing cement clinker for final pulverizing in pebble-mills. One writer states that in dry crushing the larger portion of the fine will be found at the periphery. My observation and experience differs from this view, for it necessarily assumes that the mass is not in rotation, but that the balls or pebbles simply act as a sieve or screen, which is a practically impossible condition. It may be granted that a portion of the ground material naturally finds its way to the periphery together with the coarse unground material, but this sifting only bears a relation to all the surfaces exposed, that is, between ball and ball, and between ball and lining. To illustrate, if an 8 by 6-ft. mill, inside measurement, be filled to the trunnion-outlet with, say, an average size of 4-in. balls, there will be in half the cylindrical surface of the shell an area of 75.6 sq. ft., while the grinding-surface of the balls is 1030 sq. ft. In the case of wet crushing the above also holds, except that in the conical mill there is a gradual acceleration or migration of the finer particles with the water or other liquid. In the case of some cylindrical mills it has been diagrammatically shown that the material gravitates toward the bottom in a veritable waterfall, carrying fine and coarse to the sump, while, if the mill be tapered, or of conical form, this 'waterfall action' cannot occur.

I agree with the statement that any ball-mill that discharges its product at or near the periphery is operating on the right principle. I also believe that the power acting upon a particle, which has been crushed and which has reached the periphery by flowing or sifting, should not be more than commensurate with the required energy to break that particle. This action is certainly attained to a maximum degree in the cone of a conical mill, which presents, on going from one end to the other, a constantly diminishing periphery, in which also the particle is being constantly reduced. The accelerated flow, due to the converging walls (the shell of mill), carries off the fine material as fast as it is produced, leaving the coarser particles to be reduced by constantly diminishing energies. It is thus that the conical mill regulates the power, or, as before stated, that it produces serial reduction, so that in one chamber it delivers comparatively a sledge-hammer blow to drive a spike, a nail-hammer blow to drive a nail, and a tack-hammer stroke to drive a tack. In cylindrical mills, all sizes of hammers (balls) are indiscriminately disposed throughout the mill, in opposition to practical utility and to mechanical laws.

USES OF CONDENSITE

Condensite has made plastic molding a machine process of general application. The unusual properties found in condensite, mechanical strength, resistance to heat, ease and rapidity of molding, high finish, resistance to weathering, have given a new breadth and scope to the art. The hydraulic press is taking its place side by side with the automatic screw-machine as an economic producer. It is possible in many cases to substitute condensite and plastic molding for metal or other substances fabricated by machine processes, and with a resultant economy in cost as well as betterment of product. There are thousands of places where it is cheaper to operate a hydraulic press than the one or more machine-tools which it can replace. In plastic molding a piece of work can be made at one operation in which there are bosses or projections at any desired angle from any surface, square holes, or round holes, threaded or plain, traversing the piece at any desired angle; also pieces containing inserts made of any desired metal, and, in fact, comprising work which, if done by machine tools would require scores of operations, and involve an expense for jigs and other appliances greater than the cost of the molds used in plastic molding.

The new possibilities of this old mechanical art, which again have been brought to life by condensite, are well worth the investigation of every manufacturer, regardless of the substances in which he works or the processes by which he works. It is not necessary for the manufacturer to experiment with plastic molding. There is an existing molding trade, adepts in which have been licensed to mold condensite. Given a description of the problem, and if condensite is adapted to its solution we can give a selected list of licensed molders whose facilities are best adapted to the character of work to be done.

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Among the innumerable articles made of condensite, the number and variety of which are being added to daily, are molded electrical insulation such as distributor heads and plates for automobile ignition, condulets, terminal bars, cable nipples, battery supports, lamp sockets, commutators, switch and signal apparatus, instrument cases, parts for static machines, X-ray apparatus and electro-therapeutic devices; the Edison diamond disc records; tobacco pipes; golf heads; parts used in chemical and plating processes, agitators for chemicals, guide roll for sulphate of nickel bath; toys, dolls, and novelties; syringe pipes; automobile radiator caps and steering wheels; steam valves for super-heated steam; printing plates, matrices, wood-letters and printers' furniture; change-holders; parts of butter-molding machines; type wheels for typewriters, telegraph-writers; and many others.

Condensite is the product of a chemical reaction between phenol or carbolic acid and formaldehyde. It is not a mere

compound or mechanical mixture, but is a unique synthetic chemical product resembling the finer natural gums during one stage of its manufacture. Condensite, however, possesses some properties not found in any of the gums which make it particularly adaptable for use in plastic molding. Condensite, when heated, fluxes or softens to such an extent that it may be readily molded under pressure into any desired form. The further application of heat then hardens it permanently so that it will not again soften under the influence of higher temperatures. It is in this permanently hardened form that the public is familiar with it, and the properties of condensite, of which descriptions follow, apply to this typical state.

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When requirements are exceptional in any respect, the company may be able to develop in its laboratory a special form of condensite with the particular combination of properties to insure the best results, provided the quantity to be used is sufficient to warrant the special work.

WALTER A. ZELNICKER SUPPLY CO. has issued bulletin 230, offering rails, cars, locomotives, cranes, and other heavy equipment.

COMMERCIAL PARAGRAPHS

THE WESTINGHOUSE ELECTRIC & MANUFACTURING CO. has issued a bulletin descriptive of motion picture films, lantern slides, and other aids for industrial lecture-bureau service.

The ROESSLER & HASSLACHER CHEMICAL CO. has ready for distribution its new price-list of chemicals. The quotation of sodium cyanide, 96-98%, equivalent to 51-52% cyanogen, is 37c. per pound.

REVISTA SEMANAL continues to present in attractive form the items of current trade-interest in connection with Latin America. Copies will be sent on application to office of the Revista Semanal, 30 Church street, New York.

OSCAR H. REINHOLT has returned to California after attending three conventions as delegate, where he delivered speeches on conservation. He bought some claims in Arizona from the successor of the Globe Consolidated Copper Co. of Duluth, for which is is consulting engineer.

'Graphite for the Boiler' is a booklet published by the JOSEPH DIXON CRUCIBLE CO., which tells why Dixon's pioneer boiler graphite is one of the most satisfactory remedies for the boiler-scale problem. It gives the method by which it is applied, and contains testimonials as to the results that are being obtained. Write for booklet No. 141-T.

'LESCHEN'S HERCULES' for January illustrates an elaborate piece of work in the construction of a 1000-ft. wall to form a race-way for water to operate paper mills of the Remington Paper & Power Co. involving the use of 11,000 ft. of Leschen wire-rope. It also gives illustrations of the Elm Orlu hoist at Butte, Montana, which is capable of raising 6-ton loads from a depth of 3500 ft. at the rate of 2500 ft. per minute.

GUY E. TRIPP of New York, formerly chairman of the Westinghouse Electric & Manufacturing Co., has been appointed by the War Department as Chief of the Production Division of the Ordnance Department, with the rank of Colonel, entrusted with the task of supervising and stimulating the production of ordnance supplies. Mr. Tripp was selected because of his experience in the manufacture of munitions, the Westinghouse company having obtained large contracts from the British and Russian governments immediately on the outbreak of the War. Mr. Tripp is credited with bringing to the Department the highest obtainable type of experience and ability to ensure speedy and careful production of munitions. The Board of Directors of the Westinghouse company has given him a leave of absence for the duration of the War.

MINERALS SEPARATION NORTH AMERICAN CORPORATION, Edward H. Nutter, chief engineer, announces the removal of its San Francisco office and testing laboratory from the Merchants Exchange building to 220 Battery street, San Francisco, California, where an ore-testing works has been established.

'Dixon's Silica-Graphite Paint' is the title of a new booklet by the paint department of the JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J., containing 24 pages of interesting matter. It deals with the paint problem from an entirely new angle. Ask for booklet No. 141-1B, and learn why silica-graphite paint so perfectly covers a surface.

F. C. NEWTON has resigned as general manager for the Newton Mfg. Co., and is now assistant to the general manager for the U. S. Cartridge Co., Lowell, Massachusetts.

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American Petroleum Industry

By **Raymond Foss Bacon,** Ph.D., Director of the Mellon Institute of Industrial Research, and **William Allen Hamor,** M.A., Assistant to the Director of the Mellon Institute of Industrial Research.

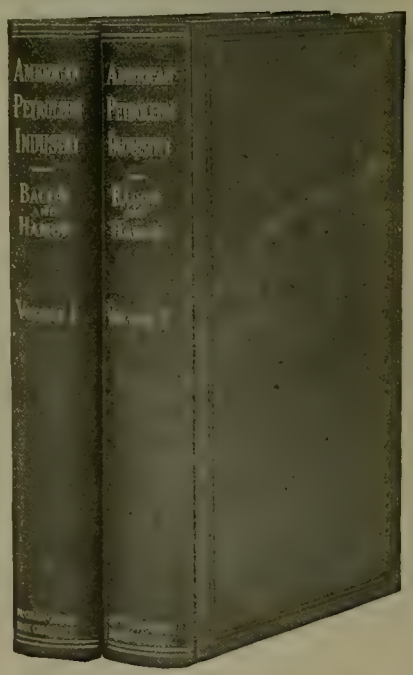
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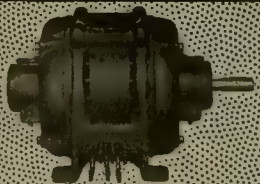
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SHORT courses of instruction to prospectors are given in the Mackay School of Mines at Reno, Nevada. We note that a class of 17 was in attendance through the four weeks in January during which this special instruction was forthcoming. Most of these adult students come from Reno, but occasionally prospectors from far afield join the class. This departure in the teaching of the art of mining is well worthy of commendation.

OUR friends at Butte appear to have had an excellent annual meeting of their section of the Institute on February 1. We have read abstracts of some of the papers presented on that occasion as published in the 'Butte Miner' and congratulate the members in Montana on being able to organize such an interesting technical session. The papers by Mr. F. W. Bacorn on shaft-sinking, by Mr. C. H. Clapp on contact deposits in British Columbia and Arizona, and by Mr. C. D. Demond on hydraulic classification should prove notable contributions to the Transactions.

NEUTRAL testimony in mining lawsuits has been recommended often as a means of escaping from the distortions of hired advocacy. It is interesting therefore to note that the experiment was made in the recent trial of the White Caps v. Morning Glory case, before Judge Mark R. Averill at Tonopah. Two geologists, Messrs. Hugh R. Van Wagenen and R. T. Walker, were chosen by agreement between the litigants, and at their expense, to advise the Court. It so happens that the testimony of these advisors favored one side so strongly as to seem partisan to that side, but we hope that the precedent may be followed by other courts, so that the day may come when expert testimony will be predominantly at the service of the Court instead of being in the hire of the litigants.

HEARST and his string of yellow journals have made a characteristic use of the 'Tuscania' disaster. In the first place he employed it hysterically as a stimulant to patriotism, although he had found excuses for the sinking of the 'Lusitania.' One ship was the victim of an act of war whereby we lost 113 soldiers on their way to fight the Germans; the other was the victim of piracy whereby 122 innocent American passengers were assassinated while being ferried across the Atlantic. Not content with a distortion of fact, he suggests that the 'Tuscania' disaster was due to British incompetence, just because his lying news-agency was suppressed by the British government. Of the 210 that were lost, 97 belonged to the British crew. Acts speak louder than words. To the common sorrow and the common resentment of Americans and Englishmen caused by the 'Tuscania' disaster we may add the common contempt for prostituted journalism.

ONE of the splendid assets of the Pacific Coast is its water-power. The possibilities are infinitely greater than the present development. California alone has a potential 6,593,000 horse-power in its streams, of which only about 600,000 horse-power is now available at the switch-board. Mr. M. O. Leighton estimated several years ago that the Pacific Coast States as a whole offered a minimum of 16,195,000 horse-power awaiting the call for industrial utilization. Having these facts in mind, Mr. Joseph W. Richards stated the other day that "electrochemical and electro-metallurgical industries are undoubtedly going to develop very fast on the Pacific Coast. There will be some set-backs, of course, due to carelessness or over-enthusiasm, but it is perfectly clear that development will take place in the same direction as in Sweden and Norway, and that a new industrial era is beginning to dawn on the Pacific Coast."

FRIENDLY co-operation, to an unusual degree, appears to mark the relations between metallurgists in Mexico at this time. We are informed that the members of the technical staffs of companies operating at Pachuca have been most generous in their exchange of information concerning practice with their professional comrades at El Oro. It may be that the enmities so rampant in the world generally, and in Mexico particularly, have prompted a growth of friendly feeling between men engaged in similarly useful work, or it may be that the isolation of life in a sea of political trouble may have drawn them together in the furtherance of a common purpose, or it may be that they are just gentlemen and scholars; whatever the cause, we record the fact with keen pleasure. The man that plays a lone hand plays a poor game; co-operation is a characteristic of

civilization. Apropros of such a manifestation of good sense, we venture to refer to the letter from Mr. F. C. Brown in our last issue. Mr. Brown, as our readers are aware, is the inventor of the agitator that is known as the Pachuca tank. Instead of 'holding up' operators at the point of his patent he appealed to their sense of fairness, asking them to pay him a reasonable fee for the use of his invention, in proportion to the number of his machines that they used. As he records, the response was generally favorable, and he found himself adequately compensated without going to law or using threats of any kind; in short, he was paid for engineering service.

A DISTINGUISHED mining engineer, recently returned from Washington, has expressed to us his belated appreciation of the good work that is being done by the American Mining Congress, as represented by Mr. J. F. Callbreath, the secretary of that organization. Like many others our friend had been under the impression, which we shared at one time, that the Mining Congress was kept going by a group of second-rate promoters and men of that ilk, although from time to time sundry professional men of high character had associated themselves temporarily with the organization. The point of this story is that the mining engineer whom we have quoted has confessed to us his discovery that Mr. Callbreath and Mr. Walter Douglas, the distinguished president of the Mining Congress, are doing a distinct public service at Washington and are performing a function necessary to the protection of the national mining industry. They need support, in the form of more extensive membership, to be secured by the formation of local State chapters. To put his opinion into effect our informant himself became a member and is now taking steps to further the second suggestion. We share his view-point. The American Mining Congress has had its vicissitudes; it was not always an agency that the mining profession could support with real enthusiasm. For ourselves, we began to take it seriously when Mr. J. H. Richards was president for several years and was supported by such men as the late Ernest R. Buckley, trying not in vain to make it a useful factor. To the Mining Congress we owe the creation of the U. S. Bureau of Mines, the Safety First propaganda, and the efforts to amend the mining law. We need an organization that will include all the diverse elements engaged in mining and we need some sort of annual convention in which these elements can be articulate. We need also somebody authorized to watch legislation in Congress in behalf of the mining industry, somebody or some committee that is out of politics and free to act independently in the interest of mining. Mr. Callbreath should be given the goodwill and support of the mining fraternity, and to that end it will be well if the California Metal Producers Association, having its headquarters here in San Francisco, and the Chamber of Mines and Oil, at Los Angeles, would join in forming a Californian chapter of the American Mining Congress.

The Railroad Problem

Agitation over the transportation problem continues; the order for fuelless Mondays is being enforced rigidly; yet the railroads are but slowly overcoming the congestion of freight that was bringing the system to the verge of paralysis. Accusations have been made by Mr. W. G. Lee of the Brotherhood of Trainmen that the high officials of the transportation systems are seeking deliberately to provoke failure in the Government management, and a wordy battle has arisen. Meanwhile evidence of active influence by railroad officials is apparent in Congress, where bills have been introduced having the purpose of compelling the return of the roads to their former managers after the War. This contest is of considerable interest to the mining world; in the past it has suffered from discriminations that even the interstate commerce laws did not succeed in curing. It is immaterial who controls the railroads if fair dealing is joined with good management. The large mining and smelting companies usually are under no great difficulty in obtaining favorable treatment, but the small operator everywhere tells a different story, and even powerful concerns, such as the Bunker Hill & Sullivan company, have had to struggle against discriminative freight-charges. The Graselli company enjoyed rates for zinc concentrate to its plant at Clarksburg, West Virginia, in combination with rates on the spelter from this point to New York that could not be duplicated in favor of Chesapeake tide-water points without prolonged and costly hearings, involving delays in themselves calculated to restrain the growth of competition. These are merely recent examples out of many. There is no discrimination in the Post-Office; it is a transportation business conducted on a vast scale, efficiently, economically, and democratically. The people would like to see the railroads operated on a similar democratic basis. It is interesting to note that the opposition to Government control is not being made by the owners of the railroads, but by the high-salaried officials. The National Association of Owners of Railroad Securities has published figures showing that one million individuals own 10 billion dollars worth of railroad stocks and bonds, that life-insurance companies representing 46 million individuals hold one and a half billion dollars, and that savings-banks representing 10 million depositors hold nearly nine hundred billion dollars; in fact, over 14 billions out of a total of 17 billion dollars worth of railroad securities is held by the general public in relatively small lots. As an example of the distribution of ownership the register of the New York, New Haven & Hartford, which is typical, reveals that the stock is distributed among 25,769 individuals, half of whom are women, and 11,915 hold less than 10 shares each, while owners of more than 500 shares each number only 367. Another interesting fact in relation to the American railroads, which makes them the people's enterprise in a more amplified sense, is that they were largely built by popu-

lar flotations of stock, and then, in the subsequent juggling of financiers for control, in errors of judgment, in mistakes of management, and in their exposure as private corporations to the demoralization of financial crises, almost the whole of them have passed through bankruptcy and re-organization, so that the men and women whose money originally built them were squeezed out. Surely the people of America have subscribed handsomely for the sake of providing arteries of commerce. Neither do the securities present and past measure the investment. Few towns have escaped assessment to purchase right-of-way and yardage to present to some railroad as an inducement not to build past it and create a rival municipality. Even bonuses in cash have been paid for such favors. Interference by the railroad managers with the successful operation of the system would be a wrong to the community, and they do right to demand proofs from Mr. Lee that he has not accused them without cause. Meanwhile, it would do much to inspire public confidence in their sincerity if the trail of their activities were not so conspicuous in Congress through bills evidently drafted to defeat the plans that the Administration had considered important in connection with its emergency effort to operate the nationalized transportation system for the welfare and safety of the nation.

Monetary Use of Silver

Silver to the amount of $490,000,000 has been coined, and against the metal held in the Treasury, $468,000,000 in silver certificates has been issued. It is now proposed to melt 150,000,000 of these silver dollars in order to provide additional bullion for export. At the same time purchases of silver throughout the year would gradually replace these withdrawals, and the corresponding foreign credits would involve our Allies in the absorption of silver for monetary purposes without discrimination, in the export balance, in favor of either gold or silver. While not equivalent to bi-metallism, this step would, however, assure an international standing for silver that would prevent the forcing of gold to a premium, or the withdrawal of gold from this country in exchange for silver, as would happen if we should attempt bi-metallism single-handed. It would appear to be a plan for enlarging the international hard-money basis for credits without the dangerous formality of monetary treaties. It is also said that silver certificates, of the lower denominations, will be recalled and exchanged for Federal Reserve bank-notes. These are quite distinct from Federal Reserve notes, of which $1,369,000,000 have been issued. The new notes would appear to be intended as a means of releasing more silver for export in proportion to the silver certificates they replace, since they are to be secured like National Bank notes against Government bonds. This is indirectly a further expansion of credit against the metallic basis, but it involves foreign credits on account of the export of silver bullion, and thus acquires an international relationship, which would tend to stabilize the issue. Such connecting links between the currency and the obligations of one national treasury to another, in which is closely involved the credits arising from trade-balances, would soon put an end to anomalies of the kind recently reported from the Far East, where American paper money was accepted only at a 20% discount. An essential condition for a sound currency system is elasticity to meet the fluctuating needs of trade, and silver in this instance performs a useful office in rendering possible the expansion demanded by the extraordinary conditions that have arisen from the War. The governments of Great Britain and France face currency problems not unlike our own at this moment, and the simultaneous demand for an enlarged metallic basis for credits temporarily has resulted in utilizing silver again in world finance, but this is based upon the law of supply and demand, and must change with altered conditions. As a matter of fact no such thing as bi-metallism can exist. It is the exchange value of silver in terms of gold coin that rules; no one ever thought of valuing gold in terms of silver.

The Control of Flotation

The description of successful experiments in the use of plain sea-water for the flotation of copper minerals, appearing in our last issue, will have interested many of our readers. The publication of the discovery will prevent anybody from obtaining a patent, and it would establish priority of invention on the part of the writer if he had already applied for patent. Publication is not only a direct way of obtaining proper credit for metallurgical research, but it prevents the perpetration of that meanness whereby an investigator is euchred out of his idea by a patentee before he himself has brought the idea to fruition. The use of sea-water as a natural frothing-agent carries a humorous suggestion. Will the patent-exploiters that are trying to establish a monopoly of flotation succeed in claiming that this new departure is a trespass on their preserves? Can anybody claim the exclusive right to dip into the ocean or even to utilize the great lake in Utah that seems to us now to be a noble body of brackish water? We think not. If, when refining zinc by electrolysis, the ore happen to contain manganese, can the patentee of a method for using manganese, in the cycle of purification and acid-regeneration, penalize the refiner for his use of the manganese placed by nature in his ore? No, fortunately for the owners of the Sullivan mine and the Consolidated Mining & Smelting Company of Canada. It would be as futile to lay an embargo on Nature as for Mrs. Partington to expect by exercise of her broom to sweep back the oncoming tide. We shall expect to hear more about the use of sea-water, Salt Lake water, and the brine of the desert region. As was suggested last week, the employment of alkaline chlorides, notably salt, is not new in flotation. In patent No. 1,182,290, of 1916, Mr. Leslie

Bradford aims to separate galena from pyrite and blende by using acidulated alkaline chlorides. He says that the solution preferably should be feebly acidulated. In another patent, No. 1,203,372, Mr. F. J. Lyster uses alkaline chlorides, among other reagents specified, to produce a differential flotation of galena in the presence of blende. He desires much more alkalinity than belongs to sea-water, for he says that the water should always contain enough alkalinity to react well with methyl orange. The mine-water at Broken Hill proved suitable for his purpose; it contains 178 grains of chlorine per gallon as against 130 in normal sea-water. These patents of Messrs. Lyster and Bradford belong, of course, to Minerals Separation, which has acquired a vast array of claims in the expectation of controlling every phase of flotation. That expectation we hope to see frustrated.

Another possible avenue of escape from the monopoly of Minerals Separation is the patent of Mr. Walter A. Scott, described in our issue of December 22. We understand that it has been used successfully in experiments made at the Ray copper mine and elsewhere. Mr. Scott's method consists in the use of oil-vapor. Oil is neither mixed with nor added to the ore-pulp, but simply introduced in gaseous form in admixture with air. Apparently this method conforms with the requirements specified in the decision of the Court of Appeals in the Miami case. There is no agitation of the pulp, and the oil is not even added to the pulp before its introduction into the Callow cell. The Court stated: "If the only agitation to which the pulp was subjected (after such agitation as in the prior art was necessary to mix the oil and ore) was the agitation of the Callow cells, we would not say that that amounted to or was the equivalent of the violent agitation of the patent disclosure and constituted infringement." This last refers, of course, to patent 835,120. The language of the Court is not lucid, but we think the meaning is fairly evident. The agitation used at Miami was no greater than that described in many prior-art patents and publications, notably the Kirby patents and the article in the 'California Journal of Technology' by Messrs. Copeland, Butler, and Wise; still the Miami agitation was held to constitute infringement, because it involved the use of a pump and a pachuca. Evidently, in order to escape infringement of No. 835,120, it is necessary to avoid any semblance of agitation in the operation of mixing the oil with the pulp. This the oil-vapor method accomplishes. Nor can Minerals Separation fall back on patent 793,808, in which bubbles of air were introduced into the pulp from a perforated coil of pipe, because the inventors, Messrs. Sulman and Picard, have themselves testified repeatedly in court that the method of this patent did not produce a persistent froth and was a failure. If these witnesses for Minerals Separation had testified that this particular patent produced either the agitation-froth effect or the Callow-cell effect they would have invalidated patent 835,120, a later patent, on which they relied to obtain a monopoly to flotation. Patent 793,808 would not suffice for their purpose because it contains no claims that would be infringed by the milling operations of today. Hence their enthusiasm in testifying that No. 793,808 produced no persistent or coherent froth comparable with the miraculous effect of No. 835,120. An attempt to contend that 793,808 contains a description of the oil-vapor process would involve them in complications either tragic or humorous, according to the point of view. It is hardly conceivable that any court would be influenced by a belated effort to trim their sails to the breeze that now blows from an entirely different direction.

It may be interesting, however, to see in what respects patent No. 793,808 differs from that of Mr. Scott, No. 1,246,665 of November 13, 1917. The first claim of 793,808 is "bringing the pulp into intimate contact with 'oil' in the form of spray and with a gas." A spray, which we conceive to be a grosser dispersion than a mist, is a suspension of minutely divided liquid particles carried in a stream of gas having velocity sufficient to maintain the state of suspension. Nothing in the nature of a spray plays any part in the oil-vapor process, in which the modifying agent is in the form of a gas that is released in the pulp as gently as possible in order to make minute bubbles, which rise quietly through the pulp in obedience to the force of gravity. The second claim of 793,808 is limited to a procedure wherein the pulp is brought "into intimate contact with oil disseminating the mixture through air." Mr. T. J. Hoover, in British patent No. 10,929 of 1910, uses the idea of introducing gas into the pulp through a porous medium. This patent was not duplicated in the United States, and therefore is not in force in this country. Such as it is, the patent, which belongs to Minerals Separation, makes no reference to the building of a bubble-column and the removal of the bubbles from the upper part of the column simultaneously with the formation of more bubbles by the continuous introduction of air; it is based solely on the use of the idea of introducing air through a porous medium in a conventional apparatus in which the pulp is aerated and then led to a vessel wherein it is permitted to become quiescent for the formation of a froth. Schwarz in U. S. patent No. 1,237,961 and Malkemus in British patent No. 15,292 refer to processes in which they treat the pulp in vessels sealed against the atmosphere and in which they repeatedly circulate different gases or vapors through the pulp. They appear not to anticipate the oil-vapor method, the importance of which, of course, arises mainly from the fact that it does not appear to infringe the Minerals Separation basic patent, No. 835,120. As to that we shall know more when the Court of Appeals in San Francisco has given its opinion in the Butte & Superior case, which will be reviewed on March 8. Whatever the decision, we may expect an appeal, by writ of certiorari, to the Supreme Court, which will then have an opportunity to remove the obscurity clinging to its decision in the Hyde case. Meanwhile, what with sea-water and oil-vapor, there is hope of a better day for the users of the flotation process.



Riffles

The Editor:

Sir—Having read the article on dredging, and the method used to save the gold and platinum, by James W. Neill, in your issue of December 8, I might say, first of all, that I am not a mining engineer, and have not heard of all the experiments which have been conducted along these lines. Possibly I am talking about a subject which has been threshed out long ago, and thrown into the discard; if so, just put this where it belongs—in the basket. If it is of sufficient interest, you may publish the whole or any part of it.

All sluice-boxes, large or small, must be set on some grade; in any that I have seen, the riffles, whether of

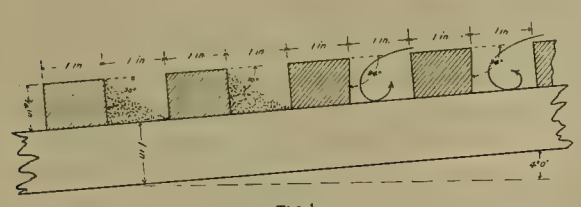


Fig. 1

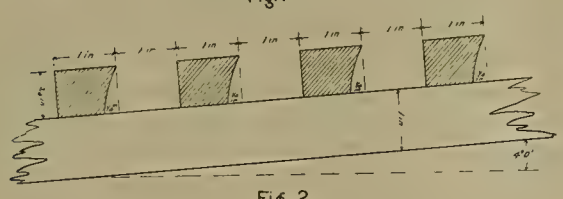


Fig 2

wooden blocks, angle-iron, or of the ladder-type, were laid flat on the bottom of the sluice, so as to throw the face of the riffles forward and away from the vertical line. I put some riffles of both kinds into a small box, which we were using to sluice the dirt from a tunnel; opposite a riffle of each kind I inserted a window-glass in the side of the sluice, and put a board over them; I then ran some dirt through, and let the water clear up. When I took the boards off the glass, I found that the riffles which were cut to the plumb had a short boiling motion, which had a tendency to keep the riffles clear, whereas the ordinary riffle seemed to be dead for a few seconds and then it would throw out a big bubble. After trimming all the blocks in this manner there was no fine gold in the tail-boxes. This sluice was set on a grade of 8 inches in 12 feet. I also found that the steeper the grade the harder the sediment would pack against the riffles, and by using a flatter grade, and increasing the water, the clearer were the riffles.

My conclusion was that the gold subjected to a boiling motion could not get out of the riffle, on account of having to climb up instead of being thrown up the slope by a bubble, the gold, on account of its high specific gravity, having a better chance to resist the velocity of the water. Still there is this drawback: the riffles have a tendency to rise. Not having the time or money to spare to prove whether this idea is worth the extra expense, I let it go with what I had done.

J. W. Dunham.

Quesnel Forks, B. C., December 24, 1917.

[The interesting observations made by Mr. Dunham recall a form of riffle with one concave side (Fig. 2), which has been used for the same purpose.—Editor.]

Labor and Rest

The Editor:

Sir—In your issue of January 5 there is a note (on page 28) on 'Labor,' by T. T. Read, taken from the A. I. M. E. bulletin.

I am in perfect accord with the writer with regard to the benefits of prohibition, and compensation laws for accident and illness, but cannot quite follow what he says in the following paragraph: "Lost time through religious holidays and other personal activities, or inactivities, of the worker, is much more important than either; their relative values being something like 1, 4, and 10, in most cases. The only practicable means of dealing with the latter seems to be the offering of a bonus, over and above wages, to the workmen who lose no time each month."

If Mr. Read is thinking about Mexico, with its numerous religious and other fiestas, I quite agree with him that some curtailment would be of benefit to the industry of that country; but if he has in mind the Sabbath or Sunday of Christian nations, and the few religious holidays they observe, I emphatically take a stand against him. Industry, after all, is just a means to an end—and the end is the well-balanced life of the individuals that make up the nation. It is not the end itself, although so many nowadays seem to think it is. If we, in these latter days, when, what we term civilization and progress are almost worshipped, imagine that we know more than the God of the Sabbath, I think it is about time that we commenced to re-educate ourselves, and learn that a certain type of human wisdom is, in holy writ, classed as foolishness in the sight of God. If a man is to be a full man his religious life must have some means of

development and expression. The words, "Man shall not live by bread alone, but by every word that proceedeth out of the mouth of God" surely indicate that there is something else besides body and mind. Develop either of these alone and what do we have: the bestial gladiator of old, or the modern speculative philosopher, who is so wrapped up in his own wisdom that his eyes are blinded to the real things of life. Are we to follow Nietzsche and Treitschke, for example?

Even in these days a man has a soul, and the development of this, along with that of the body and mind, makes the really useful citizen. I continually meet young men, fresh from college, who argue that there is no soul, because its existence cannot be scientifically demonstrated. I simply take the stand that these men are not properly educated and they have not caught the vision that the knowledge of God is the beginning of wisdom.

Now that prohibition is going ahead by leaps and bounds, there is a chance of getting back our Sunday. If not a day of labor, it need no longer be a day of carousal and 'bust.' No, do not take away the day of rest that God has given us, but let us seek out true wisdom and shape our industrial life accordingly.

Efficiency is good, when built on a sure foundation; but it now makes one ponder when he sees that this 'efficiency,' which, during the last decade has pronounced such vast material wealth throughout the world, is now being used to destroy it.

F. C. Brown.

Silver City, Idaho, January 11.

Silver and Bi-metallism

The Editor:

Sir—For the first time since 1893, when the British government startled the world by closing the Indian mints to the free coinage of silver, that metal is rapidly approaching in value and importance, as a basis for barter and credits, the standard maintained by it for many centuries. The causes leading to this condition have been in operation with increasing force for the past decade, and although the present situation has been greatly augmented by the world war, it would undoubtedly have been reached in the ordinary course of business before another decade had passed.

This has been brought about primarily by the increasing demand for silver for the purposes of coinage, and, secondly, by the increasing demand for silver for industrial uses. The first increased demand is due to two causes; a dearth of gold and an increase in the total volume of the world's business. From 1904 to 1916, both included, the world's production of gold increased from $347,000,000 in the first year to only $470,000,000 in the past year, and since 1912 the production has been practically constant. The figures for 1917 are not yet available, but the production is estimated at only $430,00,000, the decrease being due to some extent to the curtailed production in South Africa. In the meantime, the world's volume of business has increased manyfold. Inasmuch as a large proportion of the world's business today is done on credit, and as metallic money is the final basis of all credit, it is evident that the ratio between the volume of credits and the value of the metallic basis for this credit is rapidly increasing. As there is no immediate prospect for an increase in the production of gold—in fact, since the beginning of the War the production of gold in many of the most important gold-producing centres has decreased—it is equally evident that, in order to maintain that second ratio between the metallic basis and the volume of credits, the production of silver must be enormously increased, or its value, that is, its credit-purchasing power, will increase. The first is impossible; the latter obeys the law of supply and demand.

It was estimated that, on January 1, 1917, the public indebtedness of the six leading nations at war amounted to 70 billion dollars. It is further estimated that on January 1 of this year this public indebtedness had reached the bewildering sum of 100 billion dollars. On the other hand, the estimated legal-tender value of the world's available supply of gold and silver money is approximately 10 billion dollars. In this estimate it must be noted that the legal-tender value of coined silver is $1.2929 per ounce. In other words, at the present time each one dollar of metallic money must do ten times as much in credits, whereas the normal rate is between six and seven times. With the enormously increasing indebtedness of the nations at war, together with the further increasing volume of credits in the commercial world, combined with the practically stationary production of gold and silver, it is painfully evident that the metallic basis for all this credit has reached the limit of safety, making the re-monetization of silver at $1.2929 per ounce imperative in the near future. So great is this need that Mr. Balfour, on his recent visit to the United States agreed, so it is understood, to an international conference of England, France, and the United States, looking toward the re-establishment of silver, that is, the restoration of the bi-metallic standard.

The enormous increase in the consumption of silver for industrial purposes is largely due to the fact that the low price of metallic silver obtaining from 1900 to 1912 was accompanied by a corresponding lower price for sterling silver articles, and that during this period general prosperity and wages constantly increased throughout this country. The result is that people and families who formerly used plate became accustomed to, and will consider nothing but, sterling silver for domestic use. It is well known that one firm recently, at a time when silver was quoted at 85 to 87c., was unable to obtain 3,000,000 oz. imperatively needed in its manufacturing business, although a price of well over $1 per ounce was offered.

The enormous need for silver coinage, apart from that needed to pay soldiers removed from industrial occupations, is caused by the requirements both of Great Britain and the United States in settling trade balances

with the Far East, namely, India and China. Since the de-monetization of silver, England has paid her trade balances with India largely in gold. After the beginning of war, it was increasingly necessary for England to husband her gold resources. The British government prohibited the export of gold to the Far East. This was followed during 1917 by an embargo on the export of gold, except for specific purposes, on the part of the United States. It thus became necessary, in the trade with the Far East, for silver to take the place of gold in the settlement of trade balances, which, owing to the large crops in India, have yearly become heavier. In order to meet this situation during the past year, large buying orders for silver were placed in the United States; this caused the rapid rise in the months of June, July, August, and September of 1917, when, in September, a price of $1.10 per ounce was recorded in New York. Foreign financiers, realizing that a runaway market had been created, canceled many orders, with the resultant fall in price and the discussion of a government-fixed price of 85 to 86c. It is probable that the immediately pressing need of India was satisfied by purchases made for the account of Russia during the past year. However, the crisis has not been permanently relieved, in fact, it has merely been postponed, and unless it is met fairly by international government control, meaning bi-metallism, it will occur with increasing acuteness, and, instead of having a stable value for silver and a permanent exchange rate, the whole credit fabric of the world will be subject to wide and disastrous fluctuations. That such international action will be taken in the near future is beyond doubt, and that the United States must and will take the lead seems equally apparent.

The only immediately available large supply of silver is that held by the United States Treasury against outstanding notes. A feasible plan for the release that is now strongly urged is for the U. S. government to immediately contract with the producers of silver in the United States, Canada, and Mexico, for the future delivery of their production of silver at a fixed price. The United States will then issue certificates against this future supply, authorizing the Federal Reserve Board to issue certificates to redeem the present outstanding silver certificates. In this way, the enormous silver reserve in the U. S. Treasury will be made immediately available to relieve the world's credit tension and incidentally prove a source of strength to ourselves and our Allies in the prosecution of the War. It is understood that the representatives of 90% of the silver production of the three countries mentioned have expressed their willingness to sell their future production to the Government at a price of $1. Under such a plan it is anticipated that the U. S. government will become the sole purchaser of silver, and, as such, will be the sole distributor. This action will relieve the pressure and stabilize the credit basis for a time, at least for the duration of the War, and will permit the contemplated international action which by the re-monetization of silver will prevent future exchange disturbances. The demand is such that, in consenting to deliver future silver at $1 per ounce, the producers are performing a patriotic act, and it is further believed that this price is sufficiently high to stimulate the production of that metal to the utmost limit. However, it is believed that the ratio established by this price is too low permanently to meet the wild demand, and that before the conclusion of the War international bi-metallism will be estabilshed and the mints of the world will be thrown open to the coinage of silver at some ratio between 20 and 16 to 1, the former figure fixing the price of silver at $1 per ounce and the latter at $1.2929 per ounce, and that the ratio thus established will obtain for a generation or more.

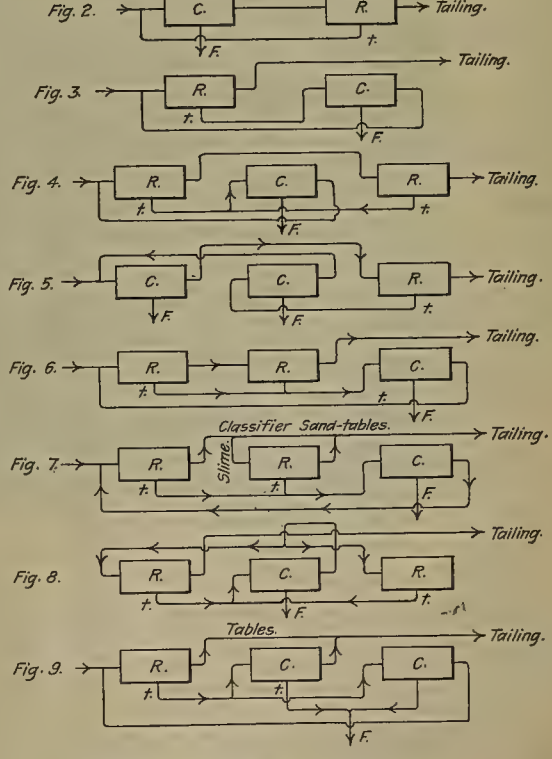
GEORGE E. FARISH.

New York, January 26.

Flotation Flow-Sheets

The Editor:

Sir—For the sake of obtaining a more comprehensive understanding of the practical application of the flotation process as practised in various mills, I prepared the flow-sheet here illustrated. It has been so instructive to me, and has presented the subject from such a different



FLOTATION FLOW-SHEETS IN VARIOUS PLANTS

angle, that I thought perhaps your readers might be interested in a short discussion of the prominent points. The first thing that struck me was the fact that even at the present time, when the flotation process is in its infancy, nearly every possible combination of rougher and cleaner cells is now practised. The second observation is that, in those mills where the best work is now being done, the flotation is effected in three sets of cells, either two roughers and one cleaner, or one rougher and two cleaners. The practical application of this observation is that, in a small plant, it is far better to have two or three small machines than one machine as illustrated in Fig. 1. The small operator is likely to install a one-cell machine, for example, the R & R or the Callow cell, or perhaps a group of M. S. cells where the pulp flows through the machine to waste. This is poor practice, because, should conditions of feed change, there is no automatic correction as is possible if a rougher precedes or follows the cell producing the finished concentrate. It may be objected that, from any cell or group of cells, a rich and a poor product may be obtained, so that one machine may act the part of rougher and cleaner, but this is seldom satisfactory.

The reduction of the tailing-loss is, broadly speaking, a question only of the amount of treatment given the pulp, but this multiplication of cells calls for more power, labor, and oils; therefore, the small mill for economical reasons must limit the number of machines. For this class of mill two machines, arranged either as in Fig. 2 or Fig. 3, will form a good combination. Fig. 2 is desirable, the pulp flowing from the cleaner to the rougher, and the concentrate flowing in the opposite direction. This may be termed a counter-current flotation flow-sheet, an example of which, with three sets of cells, I have failed to find in existing plants.

The combination found in Fig. 3 would appear preferable to that in Fig. 2. It is employed by the Arizona Copper Co. and at the Gold Hunter mill, but unless the first cell is working successfully there is no second chance of recovery. The disadvantage in No. 2 is that a variation in the amount of uncleaned concentrate and oils from the rougher cell immediately affects the finished product. The mill in which I am interested contains four M. S. and two Hebbard cells for cleaners, and a new revolving disc-machine, which throws off an excess of dirty precipitate for a rougher arranged as in Fig. 2. Any variation in the feed to the M. S. cells immediately affects the disc-machine, and this in turn reacts on the M. S. machine, thus compounding the injury. The remedy is to maintain conditions of pulp-feed.

When a set of three cells in combination is considered, it is possible to throw off the waste from the first, second, or third set of machines, always from the roughers, while the tailing from the cleaners may be returned to one of the roughers or to a cleaner. If classifiers or tables are introduced in the circuit, another set of conditions is produced by eliminating the concentrate or waste, or both, from further treatment and by returning only a middling to the flotation machine. Fig. 7 is the Inspiration flow-sheet, showing classifiers and tables after the first roughing machines. The Bunker Hill & Sullivan scheme is represented by Fig. 5, and the Silver King by Fig. 6.

ALGERNON DEL MAR.

Sandon, B. C., January 14.

Mill-Tailing and Navigable Waters

The Editor:

Sir—Believing that it is the opinion of most people interested in gold mining in California that the order of the War Department forbidding the emptying of tailings from crushing-mills into the streams tributary to the navigable waters of the State is unnecessary, and therefore unjust, I ask space in your columns to propose a method of relief for the mining industry.

Stated in its simplest terms, it is that the mills should be allowed to discharge their tailings into the streams, as heretofore, and the owners assessed, on their tonnage, for the cost of disposing of the material by dredging after it has reached navigable waters. The material from the mills is a very small proportion of the total solid material that is carried into navigable waters each year from the mountain and foot-hill districts. In times of heavy rains the quantity of natural debris carried down by mountain streams is now very great; and as deforestation proceeds, and the acreage of tilled land increases, this quantity keeps increasing also. It seems likely, therefore, that in order to keep the navigable waters in condition to serve the needs of the rapidly increasing population, and consequent commerce, of the State, it will be necessary to maintain in perpetuity a system of dredging.

It is beyond dispute that the tonnage from the mills that reaches the navigable waters and finds lodgment there cannot be more than the original quantity put into the streams—and may be appreciably less—and it should not be a difficult task for the Federal authorities to get from each mining company correct returns of the tonnage crushed.

I have no figures on the cost of dredging, but my scheme of relief is based on the assumption that it is very low where large quantities of material are handled—much lower than the cost would be, in most instances, to impound the tailing at the source. Indeed it seems to me that in the case of mills situated in deep and steep canyons the order must be nearly prohibitory.

Mining is a legitimate industry, and should be fostered rather than hampered by both the Federal and State authorities; and if it damages any other interests, these should be given relief in the manner least burdensome to the miner.

This solution of the question may have been proposed before and turned down as impracticable. If not, and this letter should open a discussion of methods for the disposal of the tailing, my purpose will have been served.

THOS. MARSHALL.

Grass Valley, January 29.

Canvas Tubing for Mine Ventilation

By LESTER D. FRINK

*Metal tubing, with blower or exhaust-fans, has long been used in supplying air to dead ends where natural ventilation is impossible, or in driving the smoke from such places, or in doing both, as the need might be. In Butte canvas tubing is now used extensively because it is found that it has many advantages not possessed by the metal. Although the use of flexible tubing is not new it has not been generally used in mining operations. Recent improvements, however, in the canvas itself and in the jointing of sections and in the manner of suspension have so increased its usefulness that it promises to add much to the efficiency of mining. A product is now on the market that is impervious to air, is fire-proof, and has a system of jointing that permits it to be put up or taken down in a few seconds. This article explains the manner in which canvas tubing is being used in the North Butte Co.'s mines at Butte, Montana.



FIG. 2. CANVAS TUBE KEPT IN THE CLEAR WHERE METAL TUBE WOULD BE DIFFICULT TO PLACE

Early in 1916, the work of deepening the Granite Mountain shaft from the 3100 to the 3700-ft. levels was

*Abstract: Bull. A. I. M. E., Feb. 1918.

commenced. A good crew was secured and satisfactory progress was made for a few months. Conditions, however, became increasingly unfavorable as greater depth was attained, the men whom we considered the best workmen dropped out one by one. In June only 60 ft. of advance was made, and it was evident that some means of bettering conditions must be devised. The advance in July of but 50 ft. left no doubt that the remaining 150 ft. would take a long time if the efforts to ventilate did not prove successful.

The Granite Mountain shaft is a down-cast; there is a good supply of air on the 3000-ft. level; a fan with galvanized tubing running from the 3000 down the shaft in the pump-end of the chippy compartment had been considered. Those that have had experience with galvanized tubing are fully aware of its drawbacks. It goes together slowly and there are always many leaky joints; it is flattened easily by concussion and is often ruined, even when care is taken not to bring it too close to the blast. Knowing these drawbacks to the use of the metal, the engineers in charge decided to try canvas tubing. This had no attached means of joining sections. Connections were made by slipping two ends over a 6-in. metal hoop and holding the canvas in place by wiring it. When two lengths were joined in this way it took but a comparatively slight weight to pull the sections apart, and probably concussion would have worked the same result. Later a joint was designed that met every condition imposed upon it (see Fig. 1). It will not only support the weight of the canvas, but will hold a much greater load, as was shown in many tests, men even swinging their full weight on the lower section. It is reversible, and also has the advantage that it can be taken apart or put together while the fan is running. The canvas covering the ring, being sewed in at each end of each length, acts as a gasket and prevents leakage of air. Each ring has a slip-joint, and the rings are made the same size so that either may be put within the other by contracting one ring. When placed together they form a circular channel. Each length of tubing comes with such a ring sewed in at each end, and when two are put together the canvas forms the gasket to prevent leakage. In drifts and cross-cuts, tension-bands, similar to the suspension-ring used in shaft-work, are put over the joints at required intervals; slack in the tubing is taken up and it is prevented from drawing back by wiring the tension-band to the clamp that grips the messenger-wire. The stronger the pull, the tighter the grip. Supporting rings were made from galvanized iron. These were put over the joints. The tubing was hung in the shaft by wires. At the first trial, 500 ft. was taken down, and one could not help noting the advantage in handling it as compared with the metal tubing, when three men and the total length were put on the cage together. An equal length of galvanized iron would make about eight deck-loads. Within two hours the stringing of the canvas was done and the fan was put to work.

It is not always safe to accept, as their true opinions, what miners say to your face, but after a shift or two the best men were back again looking for a place in the shaft, and we knew then that working conditions had improved and that better results could be expected. In August we made 132 ft. of advance and the 20-ft. sump below the 3700 was cut in a few days in September. By using pieces of different length, the tubing was kept as close to the bottom as the shaft-men wished. Of course, in adding lengths the lowest piece was always removed and the new piece placed above it. By doing this a blasting-piece was always kept at the bottom and stood the abuse when a round of holes was spit. No great difficulties were experienced in the use of the tubing in the shaft. From time to time the supports had to be lowered because the cloth had stretched, and there were a few holes to be sewed up where the tubing was cut by flying rocks, but more often the supports had to be lowered when starting the fan after it had been stopped during timbering. Velocities of the air taken at the discharge averaged a little over 5000 ft. per minute. Rock temperatures in drill-holes on the stations at the 3600 and 3700 ranged between 100 and 105° F. Judging from the volume of air delivered at the bottom of the shaft and from the fact that the men at the bottom would not let the lowest length be kept down close to them, I am sure that the No. 4 Sirocco fan used for blowing through a 16-in. tubing was larger than necessary.

Success had been so complete in the ventilation of the shaft that it was decided to put a fan and some tubing in a cross-cut being driven to the Rainbow mine. The problem here was different. Water temperatures taken near the breast gave 65° F. This is probably pretty close to the rock temperature. While this is all that could be desired as a working temperature, the accumulation of powder-gas at the breast made it impossible to maintain a full shift, and rounds were repeatedly lost. The difficulty was not to cool the place but to clear it of smoke. The breast was 2100 ft. from the nearest supply of air, an up-cast raise with a temperature considerably higher than at the breast of the cross-cut. A fan-house was erected over this raise, and 16-in. tubing run to a booster fan 1500 ft. away. Here it was picked up and sent through tubing to the breast. Though the joints between sections were the same here as in the shaft, the means of support was necessarily different. A messenger or suspension wire (No. 8 galvanized) was stretched with the aid of the common 'come along' used by the electricians in putting up trolley, the ends being fastened to stulls in the cross-cut. At convenient places, from 25 to 40 ft. apart, sprags were put up and the messenger stapled to them to prevent sag. In the hem of the tubing, at intervals of three or four feet, two grommets or eyes were inserted, and in these were fastened wire-clips or hangers. By means of these hangers the tubing could be hung rapidly to the messenger and made fast by bending the hangers together with a nail, the carbide-lamp stick, or any pointed tool made for the purpose. Between the sections a tension-

band similar to the suspension-ring used in the shaft was placed over the joints and when the slack was taken up it was wired to a clamp that caught the messenger and prevented the tubing from drawing back. The fan when started delivered about 2500 cu. ft. per minute at the end of the line.

Next morning when we went to see what results were



FIG. 1. JOINT FOR CANVAS TUBE

being obtained, we found that each low place in the tubing was a reservoir, weighted down with water. We had not thought of the condensation that was bound to come as the air went into cooler surroundings. The conditions at the breast, however, were much better than they had been, and the shift could easily work there. Cheered by the fact, we went back along the tubing, disjoined the sections, and drew the water out. As it was evident that the condensation could not be stopped, it was decided to put grommets in the bottom at both ends of each section. There being but little pressure, these grommet-eyes could easily be kept corked to prevent air



FIG. 3. A 45° BEND IN CANVAS TUBE AT THE FAN



FIG. 4. CANVAS TUBE LEADING FROM A FAN

leakage. By shutting down the fan for a few minutes each morning, the ditch-man could run all the water to the ends, pull the corks, tie up a short section, and move on to the next joint to do the same. By the time the last sections were drained, he could start back along the line untying the canvas and replacing the corks. All would then be well for another 24 hours. Later it was found that the booster-fan was not necessary, and the tubing was connected straight through, making, before the cross-cut was finished, a 2400-ft. line.

While conditions at the breast of this cross-cut could not be made as we would have liked, because of the poor supply of air that had to be used, the place was put in such shape that a round was seldom lost and the men stayed with the job, with but few changes, until the 300-ft. advance, to hole, was made. When holed, the breast of the cross-cut was just a mile from the Granite Mountain shaft, the source of the air-supply.

This was the first line that had been run in a cross-cut and we were pleased to find how easily the tubing conformed to the bends. Where galvanized pipe would have been hard to install because of jutting rock or slight turns, the canvas passed around them in smooth curves. Elbows to fit any angle were easily made by cutting the tubing to pattern, as a tinsmith cuts elbows, and sewing the two ends together.

In the cross-cut some difficulty was experienced with the leading length until a successful blasting-piece was made. This piece was made up with harness snaps fastened to ears sewed to the hem of the tubing so that it might easily be put up or taken down. Before spitting a round of holes, this piece was detached and carried back to a safe place. This would leave the discharge far enough away from the breast to be safe from flying rocks and the effects of concussion, and still close enough so that the smoke would be driven out quickly. When the next shift came on, they would replace the blasting-piece so that the air might blow directly on them.

On the 3000-ft. level in a drift we are able to supply good air to the breast with a No. 2½ Sirocco fan blowing through about 500 ft. of 10-in. tubing. In this length there was one place where the water ran on the tubing in streams. The canvas showed no ill effects from the bath. The cost per linear foot of driving was reduced about 50% in this drift and no difficulty was experienced in keeping men. It was here learned that air-motion was a great factor in making favorable working conditions. There was but a slight difference in the temperature and humidity of the air as it blew on the men and that of the drift 50 ft. back where the air velocity was slow, still the men felt comfortable and could work at the breast, whereas little could have been accomplished if the work had to be done 50 ft. back. One miner, in referring to this fact, said he could easily understand it, for when a day was hot and unbearable if he went out in his 'auto,' as soon as he got up a little speed, he was cool enough. It would be hard to get the men to move as fast as that underground, but the air can be made to move, as is attested by velocity readings of 4000 to 5000 ft. per minute recorded at the discharge of most lines not over 500 ft. long.

On the 3200, 3400, and 3600 levels, considerable use has been made of the canvas tubing in blowing to the breasts of the cross-cuts. The rock temperatures on these levels are quite high, being 100° F. at the 3200, 102° at the 3400, and 104° at the 3600. As yet a separate fan has not been put on each of these levels. All the air is supplied by a No. 6 Sirocco fan blowing from the 3000-ft. level. An air-box has been placed in one corner of the pump-compartment of the shaft. At each level, part of the air is taken out and direct connection is made to the flexible tubing that runs to the breast of the cross-cut. These headings have advanced about 300 ft. on each level. In spite of the high rock-temperatures, the working conditions at the breast have been kept comfortable. By having at each working-place a number of short lengths, the men can bring the leading piece as close to them as they wish. When the short lengths are all in use, a long length is sent down to take their place. This order of changes is repeated time and again as the work progresses.

Ten and twelve-inch tubing is used on these levels. We have found that the tension-rings, used in connection with the clamp that grips the wire, and of course the clamp too, are not necessary on the smaller tubing. When they are not used, the clips that are bent around the messenger-wire to support the tubing must be tightened carefully.

Considerably more care must be exerted in the use of the canvas tubing for ventilating raises than need be taken in cross-cuts or drifts. Where the rock temperature is high, it will be found that added advance and the consequently diminished cost will repay amply the time spent in placing and protecting the tubing. In all the vertical portions of the raises, it is found necessary to box the tubing for protection from falling rocks. These boxes need not be air-tight and can quickly be thrown together out of inch material. At the offsets the tubing need not be covered. The discharge from the top box must be covered with a screen to keep falling pieces from going down the tubing, and it must be especially well protected when blasting.

Being close to a current of good air does not always make a good place to work. A stope was started on the 2600 directly over a cross-cut that was a main air-course. On the first floor the conditions were good, on the second floor the stope was a poor one to work in, and the third floor was so hot that but little was accomplished, though neither end of the stope was 50 ft. from the main air-course. There being no working on the 2400 to hole to with a raise, natural ventilation was impossible. A No. 4 Sirocco fan with a 20-hp. motor was placed at the cross-cut and the air was taken through a 16-in. tube up a man-way and turned directly on the men in the stope. This made it a good place to work. Often stopes such as this must be worked until connections can be made with other levels, and the use of blower-fans seems to be the best alternative.

In one stope with ample connections between levels a No. 4 fan and 16-in. tubing completely reversed the air-currents, with a resulting drop of 15°. This good result was accomplished without causing any apparent ill effect in our other workings.

In places artificial ventilation is needed only for a short time, while a raise is being put through or a cross-cut or drift is being extended. Such work may take a month or less. Conditions may be normally such that it is impossible to hold men in these places. The short period of time that we need to have a fan blowing, before natural ventilation can be attained, has made us hesitate to put in a concrete foundation. Wood foundations we have tried to avoid for all electric machinery, on account of fire risk. As motor haulage with direct current is used almost entirely, and as the trolley-lines reach almost every part of the mine, we have mounted some No. 2 and No. 3 direct-current fans on trucks. Such fans, mounted on a heavy plate and arranged so that they may be turned to any angle (in a horizontal plane) with the trucks, make a satisfactory equipment for use in these places. One, complete with its auto-starter and the canvas tubing, is run to the place where needed; here it is thrown (truck and all) from the track, or placed on a siding; a messenger-wire is strung; connections are made for the electric current, and the fan is started with but comparatively little trouble. These fans are moved from place to place and in a short time will save, in labor and foundation material, the cost of the truck and time of mounting.

The examples that have been given all refer to places of considerable depth. A word might be said concerning our north-western tunnel, where a fan and tubing was used. I hope my words may in no way detract from the credit due to the foreman in charge for the good work he did. While the rest of the machinery was being installed, it was thought advisable to erect a fan at the portal, and it was but a short time before the need of it was evident. Three shifts of 8 hours each were worked and in 3 months time but one shift missed blasting and that round was made up in the next 8 hours. In November 446 ft. was driven, December's advance was 477 ft., and in January 510 ft. was made. The work was done with four men per shift at the breast, two miners and two shovelers.

It is hard to estimate how much aid the blower-fan and tubing afforded in making this advance, but it is safe to say that almost an hour per shift was added to the working day. Sometimes this must have made the difference between getting a round and losing one. It always meant that the round could be a little deeper. Both of these things have their dollars and cents value, whether we can figure the exact amount or not.

Within the last few months, many improvements have been made on the tubing. The first that was sent us from the factory was coated on one side only, had no means of support and an inconvenient and inefficient means of connecting lengths. As shipped today, the tubing is coated on both sides, has a wide top hem in which at intervals of but a few feet are grommets and suspension clips, and the ends of each section are provided with coupling-rings that make its installation simple, rapid, and satisfactory.

Royalties on Iron Ore

In the Lake Superior region of the United States, which produces approximately 85% of the total iron ore mined in the country, owners of mineral lands usually do not operate their properties themselves, but lease them to the mining companies on a royalty basis. Lake Superior iron-ore royalties, as a rule, have not been based strictly on the metal content of the ore, but rather on the favorable or unfavorable conditions of mining, the size of the ore deposit, and other variables of an intangible nature. Actual royalty payments on iron ores may vary from 10c. to $1 per ton of ore as mined. The higher royalties usually indicate that the deposits contain high-grade ore existing under favorable conditions for mining, while the lower royalties indicate that the ore is of lower metal content or that the mining conditions may be more difficult. Royalty represents merely a division of the total profit on the production of iron ore, which has been commanded by the strength of the position of the fee owner of the property. The total profit is represented by the sum of the royalty and the net profit to the operating company. There is, as yet, little tendency toward standardization, and there probably never will be, as it is a question not only of metal content, but of metal content considered in connection with the cost of mining, transportation, and other conditions.

A RAPID method for the analysis of zinc alloys is given by Mossbacher in the Journal of the Chemical Society. The routine consists in dissolving the alloy in concentrated nitric acid, evaporating to one-third its original volume, dropping sulphuric acid into the centre of the liquid, and heating until a white fume is given off. Add H_2O and EtHO and allow to stand several hours until the lead sulphate has settled. Ignite the precipitate in a crucible which has just been heated with a drop of sulphuric acid. Precipitate the copper as sulphide, and heat with sulphur in hydrogen, using a silica crucible. Precipitate the alumina and iron from the filtrate, after removing H_2S, by adding H_2O_2 and then quickly a large excess of NH_4OH. The iron is estimated volumetrically in a separate portion.

ANDALUSITE has been found in pre-Cambrian rocks in the Inyo range in California, as a segregation 500 ft. wide and extending to a known depth of 300 ft. It is traversed by stringers of quartz carrying lazulite, a deep blue hydrous phosphate of Al, Mg, and Fe, containing about 45% P_2O_5. The occurrence has been described by A. Knopf in the Journal of the Washington Academy of Sciences.

Calumet & Arizona Safety Rules

Since 'safety first' has taken rank as part of our economic culture the usual tendency to excessive detail and non-essential refinement, which is of the same order as academic exaggeration of unimportant learning in the colleges, has at times given the propaganda a touch of the ridiculous. The zeal of State officials may easily go too far in the regulation of industry in some directions, while failing to provide against other and more real dangers because of inexperience with the conditions that the workman daily meets. It is, therefore, of interest to the mining community to know what practical safety-regulations are deemed essential by one of the largest and most efficiently managed corporations in the country. The following rules, printed for the use of the underground employees of the Calumet & Arizona Mining Co. and its allied companies, represents a guide that has been evolved from the facts accumulated during years of economic administration by capable men. The pamphlet is given in full.

Introduction

More men are killed or injured in our mines from falls of rock or ore than from any other cause. The Calumet & Arizona Mining Co. and allied companies are doing their utmost to prevent these accidents, and they require that every employee exercise the greatest precaution for his own safety, as well as the safety of his fellow-men. A mine equipped with thousands of dollars worth of safety devices and worked by careless or indifferent miners, will have more accidents than a mine without a single safety device, but with miners who are always thinking of preventing accidents to themselves and their fellow workmen. It is often the case that unskilled laborers are ignorant of danger and do not know how to take care of themselves. This company asks the more experienced men to protect that class of labor by making conditions safe for them and by not permitting them to endanger themselves. A careful study of many accidents indicates that a large proportion of the accidents might not have happened if the miner had used more judgment or care. It lies within the power of the underground worker to reduce greatly the number of accidents. The exercise of this power is a duty that every miner owes to himself and to his fellow workmen. Remember to be careful under all circumstances. Keep in mind at all times the necessity of care. When caution becomes a habit there will be but few accidents. Always think before you act. Employees must familiarize themselves with these rules. Failure to observe the rules is sufficient cause for discharge.

Underground Rules

Mining. Timbering must be done at once as soon as the ground requires it.

Timbers must be watched and kept safe.

Miners must always bar down the roof and walls when necessary, and must not permit the shovelers or other employees to work under a place until it has been tested and made safe for them.

Before starting to work in a cross-cut or other place designated by the shift-boss every shoveler must examine the sides and back of that place of work. If it is beyond his power to make the place safe he must notify the shift-boss or do other work until the shift-boss arrives.

In stopes worked by the square-set method the working-floors shall be securely lagged overhead and underfoot, and in all stopes guard-rails must be placed where needed.

Every miner must examine the working-face for missed holes before he starts to drill his round. Do not start to drill before this is done, no matter whether or not a missed hole had been reported.

Do not set your machine-bar under bad ground. When this is done there is danger of an accident when you are taking the bar down again.

Every employee whose duty requires him to work with any appliance must report any defect, if found, to his shift-boss or foreman.

When working heavy or untimbered ground, care should be taken that there is plenty of room for a quick exit. All obstructions, such as cars, wheelbarrows, timber, and so forth, should be moved out of the way.

Planking over sumps and ditches must be kept secure.

No candle or lamp shall be left burning in a mine when the person using the candle or lamp leaves his work for the day.

Lights must be placed so that timbers cannot catch fire.

Employees shall inform the foreman or shift-boss of the unsafe condition of any working-place as soon as that condition is discovered.

Chutes shall be protected so that men cannot fall into them.

Men are strictly forbidden to carry tools, rails, pipe, and the like, upon their shoulders in any drift where electric wires are installed. This rule must be closely observed.

Raises, Winzes, and Ladder-ways. Any raise or winze now opening from below directly on any drift or cross-cut traveled by men shall be covered by a grizzley or by doors. The opening of offset winzes shall be protected by a fence or guard-rail not less than three feet and not more than four feet above the level of the drift.

Defects in ladder-ways must be reported immediately.

It is a serious offense to remove a ladder that is used as an exit.

Ladders shall not be removed from their usual place without orders from the shift-boss.

All perpendicular ladders must be securely fastened with ladder-hooks.

Employ care in placing ladders before using them. If there is danger of a ladder slipping, have it securely fastened before using it. Any ladder-ways, raises, or manholes found unprotected or out of repair shall at once be closed and kept closed until put in repair.

Suitable landings or platforms shall be put at the bottom of all ladders and the place where ladders are offset.

In all raises wherever possible, ladders shall be placed on an incline, with suitable landings.

In hoisting or lowering timber or tools in a manway, they shall be securely lashed, and care must be taken that no one below is in danger.

Men are positively forbidden to throw tools or material down manways.

Men are warned against going down a chute to repair it without first notifying the men above, and then it must be securely lagged overhead.

Do not go up into a chute where ore or rock is hanging in order to blast it. Do your work from the manway by taking out a lagging if necessary.

All chutes, manways, winzes, raises, and other openings shall be covered by a substantial hatch, planking, or grizzley, or provided with guard-rails or chains, and shall be kept in such condition that men cannot walk into them.

When advancing a raise be sure to have the chute and the manway covered until ready to blast. Do not run chances of falling down the chute while drilling or timbering.

Explosives. Powder-nippers shall be very cautious in the handling of explosives, both underground and on the surface. Before using the railroad or motor-tracks they shall make sure that they have the right of way. They shall use extra care in handling powder on cages and in all other places.

When explosives are delivered near the shaft of a mine a representative of the company must receive the same and see that they are safely placed.

Giant caps shall not be transported in the same vehicle or carried in the same case with dynamite or other explosives.

Giant caps shall not be stored with explosives.

No explosives shall be taken into any mine except in a securely covered case.

Men must not ride on the cage when powder is being lowered, except when it is being taken from one level to another, and then only the cager and powder-nipper may ride with the powder.

Powder must not be left on the station, but must be taken to the magazine at once.

In tamping drill-holes wooden rammers only shall be used. Tamping by strokes is forbidden and only direct and steady pressure permitted.

No steel or iron tools shall be used in tamping.

Cap-crimpers shall be furnished and must be used. Crimping with the teeth is dangerous and is forbidden.

Skewers shall be furnished for the use of all miners handling explosives, and shall be used for making holes in the powder for the fuse. No candle-sticks or other instruments shall be used for this purpose.

A miner shall never be alone when blasting, but must keep at least one man with him. Miners preparing to blast shall have a reserve light near a manway or some other convenient place in case their lights go out after spitting the fuse.

Miners about to fire shots shall cause warning to be given in every direction. All entrances to the place or places where charges are to be fired shall be guarded while such firing is going on.

The number of reports shall be counted by the miners firing them, and mis-fired holes shall be reported to their shift-boss. If at all in doubt it is better to report a missed hole than to have a missed hole and not report it.

No one shall be allowed to enter a working where there is believed to be a missed hole for a period of at least 30 minutes.

Do not extract nor attempt to extract explosives from a hole which has missed fire, but in every case insert a fresh charge above the missed explosive and then fire it.

Where boulders are being blasted by placing explosives on said boulders, and not in holes drilled for that purpose, employees shall see that the powder is well covered with clay or some other suitable material, so that it cannot take fire.

Any powder not used by the miner on his shift must be taken to the magazine or place prepared for this purpose. Leaving powder in a working-place will not be tolerated.

Do not use a short fuse to hasten the explosion, or with the idea that it is economical to do so.

Powder and capped fuse must be kept separate when hoisting into a stope.

When opening a box of dynamite a wooden chisel and wooden mallet must be used.

Using fuse for belts is forbidden.

Electrical Equipment. Every workman not duly authorized by the chief electrician or his assistant is forbidden to work or tamper with any electrical wires or machinery.

When a circuit is opened to allow repairs, a danger-signal must be securely fastened to the switch, giving the name of the workman who is employed on the line.

The signal must not be removed until notice is received from the workman.

The insulation on electric wires cannot be depended on to protect you from shocks.

All alternating-current (A. C.) power-feeders should be handled with great care; the voltage is high enough to be fatal under certain conditions. An experienced man may handle these circuits while they are alive by using proper precautions, but it is much better to cut off the power when possible.

Avoid working on any live circuits as much as possible.

Never handle electric wires while standing or sitting

in a wet place, without extra precaution to insure insulation from the ground.

In handling any circuit known to be alive, use only one hand when possible. It is best to keep the other behind the back. The most dangerous shocks are those from hand to hand.

So far as possible treat all circuits as though they were alive, even though you may believe them to be dead.

Tape the handles of your tools to prevent short circuits across them.

The trolley-pole must follow instead of leading the motor, except in places where it is impossible. The motor must go slowly when it is necessary to have the trolley-pole ahead.

The trolley-pole must not be turned while the motor is in motion.

There must be a red light on the front end of all trains that are being pushed through the drift.

The bells on the motor must be kept in good working order, and must be allowed to ring while the motor is in motion. The motor-man must notify the electrician when bells get out of order.

No one except motor-men and electricians are allowed to run a motor.

Only motor-men and brakemen are allowed to ride on a motor, and no one is allowed to ride on the cars of a motor train.

Motor-men, or men running a motor, shall report to the electrical foreman, mine foreman, or shift-boss, any defective condition of the electrical equipment underground.

All trolley construction or repairs underground must conform to the State laws of Arizona.

All electrical apparatus and conductors shall be of sufficient size and capacity for the work they may be called upon to do, and so installed, operated, maintained, and safeguarded as to reduce the danger from accidental shock, or fire, or overheating, to the minimum, and shall be of such construction and so operated, that the rise in temperature caused by ordinary working will not injure the insulating material.

CAGES. At no time shall more than nine men be permitted to ride on one deck of a cage at any of the mines, except at the Junction and the Cole, where 12 will be allowed.

Employees are forbidden to crowd around the shaft before the station signal to hoist men is given. After the signal is given the men must stand in line and not nearer than five feet from the shaft. No crowding will be tolerated.

Safety-gates must be kept closed when men are being hoisted or lowered, except when timber is being handled and the gates cannot be closed. This applies to one or more men. All lights must be extinguished before getting on a cage.

No smoking will be allowed on the cages.

When using the cage all signals shall be given while standing on the cage and not on the station.

When a cage is to be released the release signal shall be given while standing on the station and not on the cage.

Riding on a cage, skip, or bucket, loaded with tools, timber, powder, or other material, is absolutely forbidden except when necessary to assist in passing such material through a shaft, and then it is allowed only after the engineer has been notified.

When tools, timber, or other material are to be lowered or hoisted in a shaft, their ends, if projecting above the top of the bucket, skip, or other vehicle, shall be securely fastened to the hoisting rope or to the upper part of the vehicle.

In no case shall a cage, skip, bucket, or other vehicle, be lowered directly to the bottom of the shaft when men are working there. Such cage, bucket, or other vehicle must be stopped at least 15 ft. above the bottom of the shaft, until the signal to lower further has been given to the hoisting-engineer by one of the men at the bottom of the shaft, provided, however, that this rule shall not apply to shafts less than 50 ft. deep.

Riding from level to level on a cage containing a loaded or empty car is forbidden.

The cage-men and top-men shall keep a careful watch over the cages during their shift's work, and immediately report all defects, and have them repaired before continuing their work.

No person shall get off or on a cage while the same is in motion.

No men can be lowered on a cage without a bonnet.

SHAFTS. No hoisting shall be done in any compartment of a shaft while repairs are being made in that compartment, except such hoisting as is necessary in making the repairs.

When men are working in shafts, suitable covering shall be provided to prevent material from falling down the shaft.

The shaft-gates or bars must be kept closed except when in use.

If either of the two systems of signaling is out of order, extra care must be taken and a report made at once.

If an employee drops any material or tools down the shaft he shall immediately report the same to the hoisting-engineer, who will have the shaft inspected before continuing with the regular work.

SIGNALS. The regular code of bell-signals must be strictly followed.

Cages going from level to level must always give the signal for men on the cage.

All men are forbidden to use the bell-cord for calling a cage, but must use the flash-bell. Signs are placed at each station calling attention to this rule.

In order to receive compensation all injuries must be reported to the shift-boss or foreman, or have the cagers report for them, before they leave the company's property.

FERRO-MANGANESE containing as little as 20% manganese is now being used in open-hearth converters.

Sharpening and Distributing Drill-Steel

By HOWISON CROUCH

The present system of distributing drill-steel at the Empire mine, Grass Valley, California, has been in use 20 months, and the results have been so favorable as to warrant a brief description. It was developed to overcome the weakness of the old method, which became apparent when the milling capacity was increased and greater tonnage demanded. Under the old system, sharp steel was sent down in the morning for the use of the day shift, and the steel that had been dulled on the previous night shift was brought up. Part of this dull steel would be sharpened and sent down again in the afternoon for the use of the night shift. In spite of this apparently active circulation, the miner was often kept waiting for steel. If he was not lacking in the number of drills he was likely to be short of the desired lengths. Under the new system enough steel is provided for two full shifts in each stope. The sharp steel is delivered to each level but once a day, this being the last thing done before the night-shift men are hoisted, and is part of the duty of the skip-tender and helper.



DRILL-SHARPENING EQUIPMENT, EMPIRE MINE, GRASS VALLEY, CALIFORNIA

The steel is handled on two trucks specially made for the purpose, with compartments for keeping the allotments for the various levels separate. The dull steel from the previous two shifts is on the stations and is picked up the same trip. Gates are provided at the collar of the incline shaft, and the trucks, loaded with dull steel, are run direct to the tool sharpener's shop, where it is sorted and counted. After sharpening and tempering, it is replaced on the truck according to a tag, which will be mentioned later, sent from underground by the tool-boy. Any shortage due to breakage, or any extras demanded, are provided from the stock-pile, which is supposed to be kept adequate for all emergencies.

Each tool-boy is provided with a book, conveniently ruled and furnished with carbon, in which, as he visits a stope on any particular level, he records the number and the lengths of the dull drills taken out. After he has visited all the stopes on a level, he tears off a tag from his book, which is given to the mule-driver on that level, showing the number and lengths of sharp steel to be delivered from the supply at the stations to the steel-racks provided at the manways leading to the stopes. The rest of the leaf of the tool-boy's book is sent to the shop, and shows the number and lengths of sharp steel to be put on the truck in the proper compartment for that level. The broken steel is also recorded and a similar piece substituted when the truck is loaded.

The theoretical result is that each stope is always

provided with enough drills of the right kind. Each level and stope gets back on the next truck the same number and kind of sharp drills that were taken away dulled on the previous day, including the broken steel. The actual result approaches this condition quite closely, considering that four different sets of men handle the business; also due allowance must be made for carelessness and indifference. The six levels from 3000 to 5000 ft. inclusive are visited by two tool-boys, who collect and record the dull steel from the working-places. The ore-bodies are, in most cases, at a considerable distance from the shaft; consequently the steel must be transported on each level for distances varying from 1000 to 4000 ft., and must be collected from and distributed to three to twelve working-places.

The pitch of the vein is about 40°, and, therefore, to facilitate the handling of the dull steel in the stopes, slides have been placed in the manways, through which the steel is delivered to the level below, proper precautions being taken, of course, to avoid accidents. A detailed count of all steel underground and in the shops is made once every three months. The total number of pieces has remained nearly constant, refuting the objection that if an abundance of steel were furnished, there would be a high percentage of loss. The number of the longer lengths decreases, due to breakages, while the number of short drills increases. The short lengths recorded as being rejected because too short for use, correspond closely to the number of pieces of new steel cut. The record of broken drills seems to show that, when there is a shortage of drills in a stope, the percentage of breakage increases.

Hammer stopers, using solid steel and a cross-bit, are used in the stopes, while the driving is done with water-machines using hollow steel with a cross-bit. There is a considerable variation in the character of the ground drilled, both in the drifts and stopes. The foot and hanging walls, in the lower levels, are grano-diorite, and in many cases the fissure is not wide enough to afford suitable working space, and the drilling must be done in one or the other wall. Sudden increases in the hardness of the ground, especially in the drift, sometimes causes a heavy demand for drills, but if the stock-pile has not been neglected, the emergency is readily met.

The tool-shop equipment consists of two No. 5 and one No. 3 Ingersoll-Rand pneumatic sharpeners, and one pneumatic punch of the same make, for clearing the holes in the hollow steel. Concrete tanks, with screens near the bottom, are used for tempering. Crude oil is used for fuel in the furnace, which is of the ordinary type, enclosed with a substantial brick wall, having openings on three sides, and provided with a hood and large flue for carrying off the waste heat. The structure itself is built of steel, no wood whatever entering into its construction. Worn T-rails were used for the frame and rafters, to which the roof and sides of corrugated iron are riveted. The dimensions of the building are 45 by 30 ft. with eaves 15 ft. high, giving plenty of air-space, and producing the maximum of comfort for the men. The work of the shop is done by three operators and two helpers, working eight hours per day.

A daily record is kept of the work done, including new steel cut, and while the amount varies somewhat at different periods, on account of fluctuating demand for drills, it will be fairly well represented by the three months of June, July, and August 1917. During this period, in which there were 79 working days, a total of 51,029 pieces of steel were handled, or an average of 645.9 pieces per day. An itemized statement of costs follows:

Cost Per Piece

	Cents
Labor	2.56
Crude oil	0.24
Compressed air	0.24
Furnace repairs	0.03
Sharpener repairs	0.01
Miscellaneous	0.01
Total	3.09

Catalysis has been defined ironically as a screen behind which chemists hide their ignorance. W. A. Tilden defines it as "a process in which a chemical change, which, without assistance proceeds either not at all or very slowly, is greatly accelerated by contact of the materials with a small quantity of some agent, called the catalyst, which after the reaction remains undiminished." This is labored, but it is hard to improve it. For many years catalysis was hardly known outside of the laboratory, but now it is coming into use extensively in industrial chemistry. The most familiar case probably is the contact method of making sulphuric acid. In this process the sulphurous anhydride from the sulphur-burners and the air, which would remain intermixed almost indefinitely without appreciable reaction, will immediately combine when passed through platinized asbestos, forming sulphuric anhydride, and yet the finely divided platinum undergoes no change. Catalysis is used today in the manufacture of synthetic ammonia, in the oxidation of ammonia to nitric acid, also in the hydrogenation of oils for the manufacture of soaps, and in a number of other chemical processes.

Tungsten production from the Boulder district, Colorado, is now about 100 tons per month of 60% concentrate. During the earlier part of 1916 the monthly output never fell below 250 tons. It is said that the tungsten in the Boulder mines has been found not to be persistent as a rule below 250 ft., the older properties being practically exhausted, and the present supply coming mainly from the newer mines.—'The Mining American.'

Flint is frequently a result of deposition of silica concurrently with the solution of calcareous bodies, remnants of which may sometimes be seen in flint sections. The Australian flints are often crowded with the silicified remains of polyzoa, foraminifera, shell-fragments, and occasional sponge-spicules.

The Metallurgy of Nickel

*Although a small quantity of ferro-nickel is produced by the direct smelting of New Caledonian and other oxidized nickel ores, practically the whole of the nickel ore throughout the world is reduced directly in blast or reverberatory furnaces to a low-grade highly-ferruginous matte. This is afterward converted, or bessemerized, to remove nearly the whole of the iron and as much sulphur as is possible without excessive loss of nickel or nickel-copper when the latter metal is present in the ore. The process is similar to copper smelting except that, instead of producing blister metal, the nickel smelter produces a high-grade matte carrying about 75% nickel when non-cupriferous nickel ores are smelted, and as high as 85% nickel when the copper content of the ore is greater than the nickel content. An attempt to produce a higher-grade matte is fraught with considerable loss, owing to the great affinity of nickel for sulphur, causing the matte to freeze while it still contains a considerable proportion of sulphur. It is important to note that in making an 80% matte, which is the present aim at Sudbury, the loss, though temporarily heavy, is usually quite small. The loss is due to small particles of matte being projected into and retained by the slag. This loss has been overcome by mixing the converter-slag while still molten with the blast-furnace and reverberatory-furnace slags in huge settlers where, owing to the enormous bulk, the slag remains molten for a long time and gives the particles of matte ample time to settle to the bottom.

In the smelting of oxidized ores, such as those of the Caledonia, sulphur is added either in the form of pyrite, or, when there is sufficient iron in the ore, as gypsum, which becomes reduced to sulphide by the coke in the charge and forms with the iron a matte in which the nickel is collected. The matte thus obtained is refined by several different processes which will be described later.

SUDBURY PRACTICE. The Sudbury ores are of massive pyrrhotite, carrying small quantities of nickel, mainly as pentlandite, and of copper as chalcopyrite. They contain far too much sulphur for smelting in either blast or reverberatory furnaces, so a considerable quantity has to be removed by roasting before the ore is smelted. There are three companies operating at Sudbury, two of which, the Canadian Copper Co. and the Mond Nickel Co., have been producing for many years, while the third, the British American Nickel Corporation, has recently entered the field. While the metallurgy of the metal, up to the point of obtaining the high-grade matte, is in the main the same, each company has its individual methods. The Canadian Copper Co. roasts the coarse ore in heaps and the fine in Wedge roasters. Each heap contains about 2500 tons of ore, and is 60 by 100 by 8 ft. high. In building the heap, wood, usually dead pine, is laid on the ground to a height of a foot to 18 in., and is roughly leveled; coarse ore, amounting to about two-thirds of the whole, is piled on the wood. This is followed by medium-size ore, and then by fine. The wood is lighted and burns for 60 hours, by which time the ore is thoroughly ignited and continues to burn for three or four months, requiring only a little attention to prevent too great a heat and the consequent fusion of the ore. The raw ore averages 23% sulphur, which, at the conclusion of the roast, is reduced to 10 or 11%. Some sintering or fusion takes place, and the heap often has to be blasted before it can be removed by steam-shovels into the cars that carry it to the smelter. Since there is no protection from the weather, and as some soluble sulphates of nickel, copper, and iron are formed during the operation, it is evident that small quantities of nickel and copper are leached by rain and snow. There is no accurate knowledge of the proportion of metal thus lost, but it is estimated at 1½ to 2% of the original content of the nickel and copper in the raw ore. The fine ore is roasted in four Wedge furnaces, each being 22½ ft. diameter.

SMELTING. The coarse ore is smelted in blast-furnaces and the fine in reverberatories. There are seven blast-furnaces; five are 50 by 204 in. inside at the tuyeres, 19 ft. high from the hearth to the charging plate, and are rated at 500 tons per day. One has a cross-section 48 by 255 in., and the remaining one 50 by 306 in. There are two tiers of water-jackets; the lower or tuyere-jackets are 8 ft., and the upper ones 6 ft. 4 in. high. In the smaller furnaces the blast is introduced through 32 tuyeres at a pressure of 22 to 35 oz. Each furnace smelts from 300 to 440 tons of ore per 24 hours. The charge consists of:

	Tons
Roasted ore	62.2
Raw Creighton mine ore	9.8
Raw Crean Hill mine ore	8.7
Coke	11.0

The Crean Hill ore is silicious and is used to flux the iron. From the furnace the molten products flow continuously into oval chrome-lined settlers; the matte, which has a specific gravity of 4.6 to 4.8, settles, while the slag with a specific gravity of 3.7 overflows continuously through a spout into 25-ton slag-pots and is hauled away to the dump. The matte is tapped from time to time into 7-ton ladles and transferred by rail to the converters. The operation is conducted so as to yield a matte containing 25% of copper-nickel, the ratio being 2.25 parts of nickel to 1 of copper. The average concentration during 1916 was 100 of ore to 22.7 of matte, the latter containing

*Abstract: Report of the Royal Ontario Nickel Commission, by F. H. Mason.

86% of the metal content of the charge. Of the total sulphur in the charge 44% is oxidized in the furnace. In the smelting operations at the Canadian Copper Co., it is necessary to handle large quantities of fine ore and flue-dust. Formerly this material was either briquetted, or sintered, and smelted in the blast-furnace, but this practice has given way to smelting in reverberatory furnaces. These furnaces are built on raised blocks of poured slag 11 ft. above the yard-level, so that tappings can be made directly into pots. Each furnace occupies an area of 23 ft. 6 in. by 116 ft. 9 in. outside the brick-work. At the fire-end the height of the arch above the hearth inside at the centre is 7 ft. 9¾ in. and 6 ft. 8 in. above the 'skim-line'. This height is maintained for 34 ft. from the outside of the fire-wall where the arch drops to 5 ft. 11 in. above the hearth and is continued at this height to the throat. The walls and roof are made of silica-brick and the hearth of tamped sand. The furnace is fed in an unusual way: A long trough extends down each side of the furnace. Each trough has openings in the bottom 2 ft. apart, which communicate by a side grate with 6-in. iron pipes; these pipes pass through holes drilled in the roof and allow the charge to slide down on the side walls, forming an almost continuous blanket. Small bottom-dump cars run on 24-in. tracks over the troughs and keep them full of ore. As there are no charging-doors to the furnace, and as the pipes are clayed into the roof, no air enters the furnace except what is purposely introduced at the fire-end, so an exceedingly even temperature can be maintained. The pipes form a continuous line of charging-holes which extend the entire length of the furnace. The charge on the side opposite the slag-door is fed all the way to the throat. On the slag side, it is fed only as far as the slag-door, as the cold air entering the furnace during skimming cools the wall from the skim-door to the throat. The furnace is fired with coal-dust introduced through five 5-in. pipes, one on the centre line of the furnace 5 ft. 2 in. above the hearth, the others on a horizontal line 3 ft. 3 in. apart. The coal used is of good quality, having a thermal value of 13,500 b.t.u. per pound. The charge consists of:

	%
Wedge calcine and flue-dust	64.0
Raw Creighton fine	2.0
Raw Crean Hill fine	21.7
Blast-furnace flue-dust	12.3
Coal burned	22.5

If necessary, sand is added as a flux. The skimming-door allows the slag to run off 14½ in. above the hearth. The matte is tapped from time to time and sent to the converters.

The converters are 37 ft. 2 in. long by 10 ft. diam. outside, and turn on four head-rings 12 ft. diam. They are lined with magnesite-brick and have 44 tuyeres 1¼ in. diam. and 7 in. apart. Each converter has two spouts from which the products of combustion pass to the stack during the blow and the slag and matte are poured when the converter is lowered for that purpose. The charge consists of:

	Tons
Blast-furnace matte	380
Reverberatory-furnace matte	46
*Creighton green silicious ore	96
Scraps from ladles	25
Quartz	83

*This Creighton ore contains 70% silica, 0.6% nickel, and 0.5% copper, and is used primarily as a flux.

The air is introduced under a pressure of 10½ lb., and each converter requires about 6500 cu. ft. of air per minute. In commencing the blow 70 tons of matte are poured into the converter and 7 tons of flux added. The blast is turned on and maintained for one-half to three-quarters of an hour. The slag is then poured off and more matte and flux added. This cycle of operations is continued until the full charge has been introduced. The length of the blow, the amount of slag removed, and the weight of the matte and flux added after each skim, are all dependent on the grade of the matte. The resulting converter-matte contains from 50 to 55% nickel, 25 to 30% copper, 20 to 21% sulphur, and 0.2 to 0.5% iron. It is cast into ingots and shipped to Bayonne, New Jersey, to be refined by the International Nickel Co. A refinery is being built at Port Colborne, Ontario, by the International Nickel Co. of Canada, a subsidiary of the International Nickel Company.

The practice at the plant of the Mond Nickel Co. is similar to that at the Canadian Copper Co., except that the fine is sintered in two Dwight-Lloyd mechanical roasters and smelted in a blast-furnace instead of in a reverberatory. The Mond company's ores contain less sulphur and more copper than those of the Canadian Copper Co., so it is possible to use a larger proportion of green ore in smelting, and, in the process of converting, the matte is carried to 82% nickel-copper and has been carried as high as 85%. The average analysis of the converter matte is: nickel 41%, copper 41%, sulphur 17%, iron 0.6%. The matte is refined at Clydach in South Wales.

The New Caledonian ores contain neither copper nor sulphur, and average 7 to 8% nickel. They are smelted in small blast-furnaces that have a daily capacity of 25 to 30 tons of ore. The charge consists of ore, limestone, gypsum, and coal or coke ground together, briquetted, and smelted with coke. The resulting matte contains 50 to 55% nickel, 25 to 30% iron, and 16 to 18% sulphur. Before the War this was shipped to a number of European points and to New Jersey. Now most of it finds its way to Bayonne. The European method of treatment was practically the same in all cases, and consisted of deferrating or bessemerizing in small converters, pulverizing and roasting the resulting matte free from sulphur, briquetting the calcine with farinaceous material, which serves as both a binder and a reducing agent, and heating together with charcoal in retorts at a bright red heat for 48 hours. The metal, which is generally in the shape of cubes or discs, according to the shape of the briquettes, is sifted to remove the charcoal, and polished ready for the market by rotating in a drum. It assays 99.25% nickel.

Refining. Except the small amount obtained from New Caledonian ores and that obtained as a by-product in other metallurgical operations, the nickel of commerce is refined by one of three processes, namely, the Orford, the Mond, and the Hybinette. The Orford is the oldest process and is based on methods employed in England before the Sudbury ores were exploited (1886). It is based on the fact that if a matte consisting of sulphides of nickel, copper, and iron is melted with sodium sulphide, the product separates into two layers. The upper and more fusible layer is composed of double sulphides of copper, and sodium, and iron and sodium, with a little nickel sulphide, and the lower layer of nickel sulphide with small quantities of copper sulphide. In carrying out the process, the matte, as received from Sudbury, is fused with 60% of its weight of nitre-cake and sufficient powdered coke to reduce the nitre-cake to sulphide in a basic-lined open-hearth reverberatory-furnace. The mixture is allowed to remain in the furnace for four or five hours, and is poled frequently with green poles, which not only thoroughly mixes the sulphides, but, on account of the hydro-carbon gases given off, materially assists in reducing the nitre-cake to sulphide. When the operation is finished the mixed sulphides are cast into molds, the heavier nickel sulphide sinking to the bottom. If a very clean separation is required, the nickel sulphide is again treated with nitre-cake and coke. When the sulphides are solidified they are turned out of the molds and a blow by a hammer separates the nickel sulphide from the mixed copper-sodium and iron sulphides, which are called the 'tops.' The tops are leached with water, dissolving the sodium salts which are evaporated for further use. The residue, consisting of copper and iron sulphides and most of the gold and silver, is smelted and blown to blister, which is sold to copper refiners who recover the nickel content, usually about 2½%. The bottoms, which still carry a small quantity of copper, are ground and roasted, with a little salt, in a reverberatory furnace. This converts the copper into soluble sulphate and chloride and the nickel into insoluble oxide. The leaching of the calcine gives a solution containing the copper and some platinum, palladium, and rhodium, which is treated by a secret process for the recovery of the precious metals. The nickel oxide residue is reduced to metal in a reverberatory-furnace fired by oil. The product generally contains 99% nickel, together with a little cobalt, iron, and some of the platinum group of metals. When a pure product is required this is refined electrolytically.

The Mond process of refining nickel-copper matte is unique among metallurgical processes. The matte is ground in ball-mills to pass 60-mesh, and roasted in straight-line double-deck calcining furnaces. The calcine, containing less than 2% sulphur, is leached with 10% sulphuric acid. This removes 70% of the copper and about 1% of the nickel. The residue, containing 51% copper and 21% nickel, is washed, dried on vacuum filters, and transferred to the reducing towers. The latter are vertical towers built of 24 short-cylindrical sections to a height of 40 ft., each section contains a hollow shelf, which permits heating by producer-gas to 350°C. The leached calcine is introduced at the top, and as it descends is carried alternately from the centre to the periphery and from the periphery to the centre by rabbles attached to a central shaft. A current of water-gas ascending through the tower reduces the copper and nickel oxides to metal, and the ferric to the ferrous oxide. The reduced material is carried through a gas-tight conveyor to another tower of similar construction but with solid shelves. Here, as the material descends, it meets a current of carbon monoxide gas at a temperature ranging from 50 to 80°C., which converts the nickel into nickel carbonyl, a gaseous product, that is carried to the decomposer. After passing through the volatilizer the mixed metals are returned to the roaster and once again start their journey toward the volatilizer. This continuous round, which is carried on for 7 to 15 days, is necessary, because, after a part of the copper has gone into solution as sulphate, the nickel oxide forms a protective coating and prevents further solution of the copper oxide, while in the volatilizer, after part of the nickel has been removed, the copper stops further volatilization. The final residue, which contains metals of the platinum group together with rhodium, gold, and silver, is sold to precious-metal refiners. The decomposer is a cylindrical vessel containing a central tube with holes through which nickel carbonyl passes into the outer vessel. The tube is kept cool by an inner tube through which water circulates, thus preventing the dissociation of the nickel within the tube. The outer vessel is maintained at about 200°C., at which temperature the nickel carbonyl is decomposed into nickel and carbon monoxide. The carbon monoxide is returned to the volatilizer, where it volatilizes a fresh supply of nickel. The granules of nickel, formed by the decomposition of the carbonyl, are kept in continuous motion within the decomposer by means of a right and left-handed worm-conveyor which delivered the granules to a sifting-drum. The smaller granules are returned to the top of the decomposer and the larger ones removed for the market. This continuous movement prevents the granules from adhering to each other. The nickel deposits on the granules in concentric layers and thus they grow gradually. It requires about two months to produce a shot ⅛-inch in size, and six months for a ⅜-in. shot. The copper-sulphate solution formed by treating the roasted matte with 10% sulphuric acid contains 2 to 2½% of nickel. The sulphates are separated by fractional crystallization.

The last process in commercial use of refining nickel-copper matte was invented by V. N. Hybinette and has been in use for many years at Kristiansand, Norway, for refining matte produced at Enje, Ringerike, and Stavanger. This process will be used by the British American Nickel Corporation at Sudbury or where they place their refinery. The bessemerized matte obtained from the smelters at Enje and Ringerike contains about 80%

of nickel-copper and averages 47% nickel and 33% copper, so, it will be seen, it is similar to the matte produced at Copper Cliff, Ontario. The matte, which is received in a granulated form, is roasted to remove the bulk of the sulphur and leached with a 10% solution of sulphuric acid. The residue is melted and cast into anodes 3 ft. by 3 ft. 6 in. by ½ in. thick. The anodes contain about 65% nickel and 3 to 8% sulphur, the remainder being copper with a little iron. The nickel and the copper are deposited separately. The electrolyte used for the nickel deposition contains 45 gm. nickel and 3 to 5 mg. copper per litre, and is supplied by rubber tubes to the cathode diaphragms and kept in continual motion. After circulation the electrolyte contains 2 to 3 gm. copper per litre, and is then passed over waste anodes that precipitate the copper and re-supply nickel to the solution. The amount of waste anode during the electro-deposition of the nickel—about 30 to 40% of the original weight—is sufficient to re-vivify the exhausted solution from the nickel vats. These solutions are never thrown away, as the cementation of the copper purifies them sufficiently. Any fragment of waste anodes remaining after the cement copper has been cleaned off are crushed, roasted, leached with 10% sulphuric acid, and re-melted into new anodes. During the deposition the anodes are contained in a special canvas bag. The cathodes are made of iron plates rubbed with a thin wash of graphite and water, and are arranged in parallel; the voltage depends on the number of vats in use; three to four volts per vat being used, according to the current density, which is 8 to 10 amperes per square foot of cathode. The nickel deposition takes 10 days to complete, and the deposited nickel is about ⅛ in. thick and weighs 20 to 30 lb. It has the usual corrugated warty appearance, but is dense, the warty or stalactitic growths being normal, and gives no trouble by short-circuiting. The plates are washed with weak acid and cut up and marketed without being melted. The precious metals become concentrated in the anode slime, which is melted into fresh anodes, and electrolyzed separately, the final slime being sold to refiners of precious metals. The copper is recovered similarly to the nickel, in a separate plant, but on sheet-copper anodes, and without bags around the insoluble lead cathodes. The current density is 10 amperes per square foot of cathode at two volts. The copper takes seven days to deposit, and the precious metals are obtained from the anode slime, as with the nickel.

Metallic cerium is obtained by the electrolysis of the chloride or fluoride, and if alloyed with iron, it emits sparks when rubbed on a hard rough surface. This property has been utilized in the manufacture of gas lighters. An even better material for this purpose is made by submitting an alloy of aluminum, magnesium, and cerium to a current of hydrogen at a dull red heat. The alloy takes up some of the hydrogen, forming a hydride that sparks brilliantly when rubbed on a rough steel surface.

Minerals Separation Contracts

The 'Boston News Bureau' says:

Four different methods of assessing royalties in payment for use of flotation in the treatment of ores have been determined upon by the Minerals Separation company, which controls 50 patents in the United States.

The bases for these payments follow:

(1) Percentage of gross value of all metals recovered from total ore milled, irrespective of methods of treatment so long as flotation is used anywhere in the flow-sheet.

(2) Unitage, a fixed rate per unit (20 lb. per short ton) or per ounce of various metals recovered from total ore milled if flotation is used anywhere.

(3) Poundage, meaning fixed rates per pound or per ounce of various metals recovered from any material treated by flotation.

(4) Flat rate, or fixed rates per ton of copper ore milled, according to average daily tonnage of mill-feed.

Where complex ore occurs royalties shall be paid at regular rates applicable to all and each of the resultant products. The company limits the flat-rate schedule of royalty for copper to ores yielding copper concentrates which do not contain admixed metals in commercial quantities. Secondary values in commercial amounts must be paid for in additional royalty.

Applying to copper ores the schedule provides (1) for payment of 2½% of gross value of total copper contained in all concentrates recovered with additional 2½% payments on gross value of any other metals secured from concentrates and paid for by smelter; (2) 6c. per unit for total copper contained in all concentrates recovered together with 2½c. per ounce for all silver and 25c. per ounce for all gold recovered and paid for by smelter; (3) 1c. per pound for all copper contained in such concentrates or products, together with 5c. per ounce for silver and 50c. per ounce for gold, this applying only to metals recovered by flotation; (4) the flat basis provides for the payment of 12c. per ton of ore treated up to 4000 tons daily, 10c. per ton for the next 2000 tons, and 9c. per ton for the next 4000 tons treated daily. The flat basis of payment applies to the entire tonnage of copper ore treated, provided any portion has been handled by flotation, except that copper ores smelted direct without any previous process shall be exempt from royalty payment.

Where the unit basis shall be adopted by a zinc company securing a license, additional payments shall be made at the rate of 2c. per unit for lead, 6c. per unit for copper, 1c. per ounce for silver, and 25c. per ounce for gold contents. Payment where flotation alone is used calls for additional payments on zinc ores of 0.3c. per per pound for all lead contents, 1c. per pound for copper, 5c. for silver, and 50c. per ounce for gold.

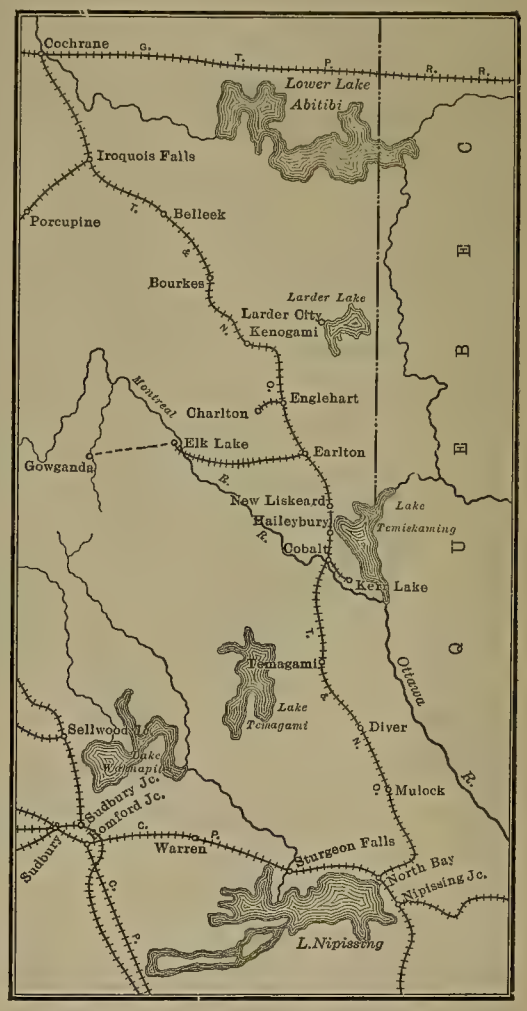
The contract secured by the Anaconda and Inspiration companies was adopted before the present schedule was determined. This calls for 4c. per ton of ore.

Ontario Gold and Silver in 1917

By THOMAS W. GIBSON

*Among the metals, the adverse effects of the War fell principally upon gold. In times such as the present, when commodity prices have greatly increased and labor is scarce, the intrinsic value of gold is lowered, since any given number of ounces will only be taken in exchange for a reduced quantity of goods or work. Hence, a gold mine, while nominally receiving exactly the same prices as before for its product, suffers by the increased cost of labor and supplies. Other metals have advanced in price, and consequently the producers, although their products cost more, are enabled to recover this additional cost, and in some cases much more, from the consumers. The gold mines of the Province produced about $8,750,000 in gold, as compared with $10,339,259 in 1916. The largest mine, Hollinger Consolidated, ceased paying dividends, but remained in operation, producing about $4,450,000 in gold. The mill of the Dome Mines closed in November, the low-grade ore not being able to stand the heightened cost of production. All the other Porcupine companies continued working, namely: McIntyre-Porcupine, Porcupine Crown, Porcupine V.N.T., and Schumacher. The Dome output for the nine months was $1,219,000; that of the McIntyre-Porcupine for the full year, about $1,600,000. The total output of the Porcupine camp was in the neighborhood of $8,300,000. The history of the Porcupine field so far has been very satisfactory, and there is no doubt that, when conditions return to the normal, good profits will again be realized.

Next to Porcupine, Kirkland Lake is the most active and advanced gold district. There are now two mines producing bullion, Tough-Oakes and Teck-Hughes. Properties which are more or less rapidly being put into condition for production are: Lake Shore, Kirkland Lake, Wright-Hargreaves, and some others. Mills in operation and under actual construction will have a capacity of 530 tons of ore daily. It is being demonstrated that gold occurs in important quantities in many and widely separated areas of northern Ontario. Among the younger districts of promise are: Munro township, West Shining Tree, Boston Creek, Bourke's Siding, Kirkland-Tashota, and Powell township. The Croesus mine, in Munro, which showed quartz of remarkable richness, and whose plant was destroyed by the disastrous forest fires of 1916, is again in operation. The shaft is down to a depth of 400 ft., and the continuation of the vein, which had faulted, is being looked for. The Anderson find at Bourke's, and the Murray-Mogridge property at Wolfe Lake are showing well. At Boston Creek, the Miller Independence and Patricia (formerly Boston-Hollinger) are the principal prospects. West Shining Tree continues to excite hopes by samples showing much visible gold. Little, if anything, is at present being done at Tashota, the Tash-Orn Co. having got into difficulties and ceased operations. At the old St. Anthony mine, Sturgeon lake, work has been going on for some time under the new owners, but production has not yet begun. The



MAP OF A PART OF ONTARIO

Canadian Exploration Co. has closed the Long Lake mine, near Naughton, on the Sault Branch of the C. P. R. It is a poor year that does not yield one or more new gold camps in northern Ontario. The latest was a find made at the head-waters of Lightning river, last autumn, by a prospector named Cochenour. The vein has been sampled, and the assay values run from $20 per ton

*Abstract: Can. Min. Inst. Bull., Jan. 1918.

upward. The geology is said to resemble that of Porcupine, and a considerable number of mining claims have already been staked.

The silver output was practically equal to that of 1916, namely, 20,000,000 oz., but owing to the higher prices for silver, the money value was considerably greater, that is, nearly $16,000,000 in all. The Cobalt mines are still the sole source of silver. The Nipissing mine, so long pre-eminent, was last year surpassed in production by the Mining Corporation of Canada, which operates the Townsite-City and Cobalt Lake mines. Beneath the streets and buildings of Cobalt, the rich veins of the Townsite-City yield an abundance of high-grade ore. Last year the Mining Corporation's production amounted to about 5,000,000 oz., or say, one-quarter of the total output of the camp. Nipissing mine is still producing much silver; last year the yield was about 3,750,000 oz., nearly equal to that for 1916. The dividend payments by this company have now reached more than $17,000,000. Kerr Lake also continues to produce freely, practically equaling the 1916 record with 2,500,000 oz.; Coniagas yielded about 1,300,000 oz.; McKinley-Darragh-Savage about 1,000,000 oz.; O'Brien and Temiskaming did fairly well. The last-named mine has not found, at the lower diabase contact, the hoped for bodies of bonanza ore. Some ore was obtained, but two separate reports made to the shareholders during the year do not hold out hopes of a large future production. La Rose, Crown Reserve, Hudson Bay, Beaver, Buffalo, Trethewey, and other well-known mines produced bullion, but on a smaller scale than in former years. Interest in Gowganda camp was revived by the rich high-grade vein found in the Miller-Lake O'Brien mine, and development on nearby properties has been undertaken. On the whole, the mines of Cobalt met the situation of 1917 in good style, and were able to market a large production at the prevailing high prices. The reported negotiations of the British and United States governments, to purchase 100,000,000 oz. of silver, will mean much to Cobalt if carried out, especially if the price is raised from 85 cents to between 90 cents and $1, as is now suggested.

The flotation process of concentration has been widely adopted in Cobalt, and will serve to prolong the life of the camp. There is some apprehension that the Minerals Separation company will endeavor to exact excessive royalties. The Cobalt mine-owners believe that the patents are of German ownership, and it is understood that the Dominion government has undertaken to investigate. The 1917 silver find was in the township of Corkill, some distance south-east of the Gowganda deposits. The discoverer was Hugh Miller Kell, and the ore is said to be rich, though development has not yet proceeded far.

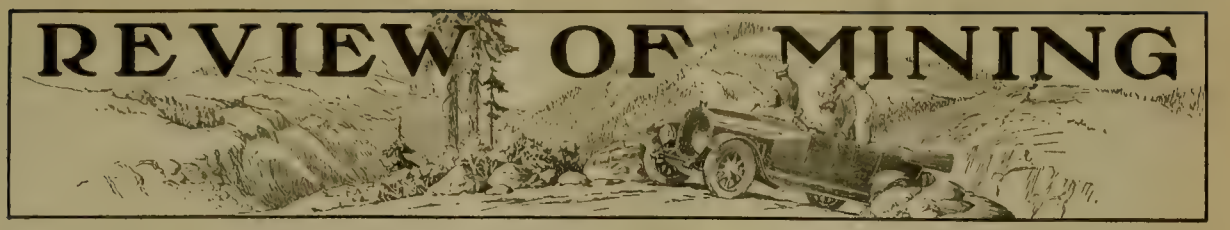
One satisfactory feature of mining in Ontario is the willingness of individuals and companies, that have made good in one area or mineral district, to try their fortune in another. A notable instance of this is the Timmins group, who, after successful operations in La Rose silver, took up the Hollinger gold claims and made another big mine there. Other examples are: Crown Reserve Mines, which put part of the profits made in the mine at Cobalt into the Porcupine Crown gold mine, and now Newray; Buffalo Mines, which is operating the Teck-Hughes in Kirkland Lake, and the Beaver, now developing the Lake Shore claims at the same place. Coniagas, too, has gold claims under development at Porcupine.

Flotation in Michigan

While there is hope that the flotation process of the Minerals Separation Co. may be applicable to the amygdaloid lodes of the Michigan copper country, there really is not much reason for expecting that any large sums will be realized from its practical operation on such sand. Long continued experiments by the Calumet & Hecla interests on their conglomerate sand showed successful results, but on the Osceola sand no such results were secured. Ultimately the Calumet & Hecla will treat all of its conglomerate slimes by the flotation process. This includes the slime from the current mill operation as well as the slime from the sand-pile from the lake, even the slime treated by leaching. At the White Pine property there are two classifications of tailing that will be treated by the flotation process. One is the regular slime and the other a grade of light and flaky copper that ordinarily is not saved, but that is caught by the flotation scheme. They operated a 50-ton plant for an experimental period and now are handling practically all of the tailing with a 600-ton plant, most of which is in operation at this writing. No other mines in this district have experimented with the process and while some of the concentration experts are planning on trying the scheme, they are frankly dubious as to its success.—Boston News Bureau.

An Italian geologist, E. Crivelli, has recently made a notable contribution to the study of the magmatic or so-called igneous origin of petroleum, based in part upon observations of the intimate relationship between the mineral and the oil deposits of Peru. It is shown how the oil probably may have been formed by migration of hydro-carbon derivatives through fissures from deeply seated magmas, and much new light is thrown upon the volatile metal-carbon compounds, as, for example, the carbonyls and acetylides of nickel and iron. He also shows that the peculiar deposits of so-called coal in the high Andean valleys may have resulted from reactions between such magmatic emanations as hydrogen, methane, ethane, carbon monoxide, and others.

Experiments to discriminate the colloid minerals have recently been made by Cyril W. Greenland of Columbia University. He tested staining with dyes, and it was concluded that the taking up of a dye by an amorphous mineral substance may be due to the penetration of the liquid through capillarity in cracks rather than to adsorption, and that no general method for proving the gel-nature of a mineral can be based on our present knowledge.



NEW YORK

Fuel Situation.—Stocks.—Toluol Manufacture.—Freight Congestion.

The coal situation still claims first attention in spite of optimistic forecasts by the Fuel Commissioner of an early return to normal industrial conditions and 'fair and warmer' prognostications from the weather bureau, which failed to materialize. The temperature is again of the zero variety, coal arrivals are of spasmodic occurrence, and the prospect of the full 12 days vacation during the present month is more than probable. There has been a ready acceptance of the conditions invoked by the authorities and no question as to their necessity. The feeling that persists is that prevention would have been better than cure. Personal loss and discomfort has been considerable, and hundreds of apartment houses in the city have been without heat for the majority of the time. One householder is reported to have temporarily weathered the crisis by donning his furnace clothes, taking a job as driver of a coal wagon, selling the first load to his wife, and returning with his resignation. A sidelight in the coal situation is seen in the fact that the New York State breweries consume about 2400 tons of coal per day. The sanity of diverting this amount of fuel to the more essential industries could not have been questioned.

The majority of stocks, including mining shares, have shown a marked appreciation in value during the week. This has been variously attributed to the failure of peace negotiations between Germany and Russia, the strike in Germany, and optimistic rumors with reference to the possibilities of a general peace in the near future. Liberty Bonds, however, all reached new low records. This was possibly due to liquidation in preparation for the next loan which, it is rumored, may bear interest at 4½%. The British $100,000,000 loan of one-year 5½% notes matured on February 1. Of this amount only about $1,000,000 was converted into 20-year bonds. The payment for the balance was met by cash to the amount of $40,000,000 from an 80,000,000 yen loan to Great Britain from Japan and available in New York, $10,000,000 from the same source in consideration of 300 lakhs of rupees received from the British government, and the balance, about $50,000,000 from British funds in this country.

The urgent need of toluol for the manufacture of explosives has led to drastic action on the part of the Government to increase the supply. The gas plants in New York are to be equipped with the necessary apparatus, which is to be paid for out of government funds. The aim will be to extract the maximum amount of toluol and to make a monetary compensation to the gas companies. The British thermal unit of measurement will replace the present candle-power unit. The change to by-product ovens has been under consideration for some time, but the companies were unwilling to go to the expense involved without some guarantee that the outlay would be justified by the returns and that the demand for the by-product would persist long enough for them to be recompensed. The difficulty in arriving at any satisfactory settlement on this basis led to the Government taking the initiative, installing the necessary plant, and paying the companies a satisfactory price for the by-product. It has been pointed out that, as only 20% of the gas is used for illuminating purposes, the British thermal unit is the more reasonable standard to adopt; and an equivalent of 650 B.t.u. per candle-power has been fixed.

Further suggestions for the alleviation of freighting congestion in and around the city are being made. One scheme provides for tunnel roadway under the Hudson river to connect New York with Jersey City. Another involves the building of a traffic bridge across the river to connect these two points. The tunnel scheme is to be discussed at a conference of governors, mayors, and congressmen; and it seems probable that some steps will be taken to put the plan into execution. At present 30% of the freighting is done over the lines of the New York Central railroad, the balance being floated across the Hudson. During the past 25 years about $700,000,000 has been expended in enlarging and improving terminal passenger stations in the city and affording other facilities for travelers. Nothing has been done to improve freighting conditions.

The Interborough Rapid Transit Co., operating the subway and elevated lines, reports an increase in the number of passengers carried during the latter six months of the year of 9,475,402 as compared with the corresponding period in 1912. This makes a total of 374,653,402 for the half year. The traveling millions view the company's success along these lines with apprehension of increased discomforts.

There were 1023 elections to membership of the Institute of Mining Engineers during the past year, bringing the number of members to 6528. This is an achievement for which due recognition must be paid to the work of the Committee on Increase of Membership. The forthcoming annual New York meeting, although shorn of a proportion of its usual social attractions, promises to be a still greater success in other directions. Over 50 papers are to be presented and dealing with a variety of subjects. The February bulletin contains the names of nearly 200 members of the Institute who are now in Military Service.

An interesting feature of the quarterly report of the New Jersey Zinc Co. is the mention of the profit-sharing distribution to employees, which amounted to $450,000 for the three months ended December 31.

EAGLE PASS, TEXAS

Metal Importations From Mexico.

It is shown by the records of the United States custom offices at the different border ports of entry that there was a large increase in the quantity and value of importations from Mexico into this country for the year 1917 over those of the preceding year. In fact, it was one of the best years from a trade standpoint that has been experienced since the revolutionary period began in Mexico, more than seven years ago. While the official statement of importations and exportations through the different ports of entry has not yet been compiled, it is known that the showing is gratifying to the trade interests. The total value of the exports through El Paso for 1917 was $5,660,709, which was an increase of $1,497,970 over the value for 1916. The proportion of increase at Eagle Pass and Laredo greatly

exceeded that at El Paso, owing to the fact that the railroads leading into Mexico from the two former towns have been open for traffic almost continuously during the past several months, while the line running south from El Paso has been out of service at long intervals on account of the depredations of revolutionists and bandits.

The metal and ore importations through El Paso during the year 1917 showed a good increase. The figures of these importations through Laredo are not as yet available, but it is stated that they amounted to much more than those for the El Paso custom office. The most notable gain was in copper. There was a falling off in the importations of lead and zinc. The figures for El Paso for the year may be taken as a basis for the other border ports of entry.

The value of the total imports for 1917 amounted to $2,804,634, a decrease of $155,164. Gold-ore importations for the year amounted to $3599, a decrease of $32,715; gold bullion imported was $7721, a decrease of $72,720; silver ore increased from $738,262 to $1,249,837, surpassing 1916 by $511,575; silver bullion, on the other hand, dropped from $566,730 to $165,278, a decrease of $401,452. The total value of copper ore imported was $93,683 for 1917, against $86,266 for 1916, a gain of $7417; lumber importations amounted to $136,130 against $56,506 for 1916, an increase of $79,624. Lead fell off $44,577, total importations for 1917 having been $239,504 as against $284,081 for 1916. Zinc receipts show a still worse slump, the total decrease for 1917 having been $418,391, the total ore imported for 1917 having a value of only $342,932, while that of 1916 reached $761,323.

LEADVILLE, COLORADO

MOLYBDENUM AND MANGANESE MINING.

Developments in the new molybdenite district at Climax, north of Leadville, are being rushed ahead. Three big companies, the American Metal Co., the Molybdenum Products Co., and the Pingrey Mines Co., are actively opening the ore-reserves in their properties and erecting concentration plants. At Buffher, a mile below Climax, in Summit county, the Molybdenum Products Co. is constructing a 250-ton mill in which a secret process for the treatment of molybdenite will be used. The process, which was perfected last year after a long period of experimenting, is reported to be highly successful. The ore averages 1% molybdenum. An aerial tramway nearly two miles long is being erected from the mill to the company mines on Bartlett mountain. At Climax, the American Metal Co. has almost completed the new 250-ton mill that has been under construction for several months. Work on the mill was started last August under the direction of J. H. White, who is superintendent for the company. Boarding-house, bunk-houses, shops, offices, and other buildings have been erected near the mill and a boarding-house and bunk-house have been built at the mine a mile above on Bartlett mountain. A tram has been completed to carry the ore to the mill. The American Metal Co. controls the largest tract of molybdenite ground in the district, and through an 800-ft. adit and numerous cross-cuts, has blocked out an immense tonnage. The ore averages 1% molybdenum. The mill is equipped with Blake crushers, ball-mills, Callow and Janney flotation machines, and a Portland filter. The company plans to put the mill in operation and begin shipping concentrate during the present month. For several weeks the Pingrey Mines Co. has been engaged in opening the orebodies in the Black Metal group of claims, also on Bartlett mountain. O. A. King, the manager, states that a large tonnage has been blocked out and a number of shipments have been made to the Leadville district mill where a satisfactory concentrate was made. Plans are now being completed for the erection of a 500-ton mill near the company's ground at Climax.

The Denver Mining & Milling Co. has just completed overhauling and improving its mill at Wortman and will start milling during the month. A large body of lead-zinc sulphide has been blocked out in the old Wortman property; a milling process has been perfected and the necessary machinery erected.——Three hundred men are now employed in the district comprising Wortman, Climax, and Buffher, where a year ago there was none. The operations of the large molybdenum companies have been the direct cause of the present prosperity and have indirectly brought about the opening of other smaller properties. It is estimated that 1000 men will be working in this district during the summer.——Lessees operating through the Hibschle shaft on the Wolcott ground in the Down Town district have discovered a large body of manganese ore, averaging 31% metal. The first shipment will be sent to the Colorado Fuel & Iron Works at Pueblo this week. The orebody is the extension of one of the big deposits recently uncovered in the Northern property, which is one of the heaviest producers of manganese in the district.——A company of lessees, headed by Harry McKeen, has just discovered a strong ore-shoot on the 1000-ft. level of the Evelyn property in Graham park. The ore is a high-grade silver sulphide and is believed to be one of the rich veins that was formerly developed in the Mahala property adjoining. A steady tonnage is being produced.——John Cortellini and associates have taken a lease on the old Sunday property on Ball mountain and are extracting a small tonnage of rich gold-lead ore. Work is being carried on through the Sunday shaft. The ore-shoot is strong and continuous and shows promise of developing into an important deposit.——The Dold Mining Co., operating through the Northern shaft in the Down Town district, is now completing plans for re-opening the Newell shaft. A large tract of ground north of the Newell and extending into Poverty Flats has just been secured under lease, and development from the Northern has discovered another large deposit of high-grade manganese. The situation of the Newell shaft makes it the logical hoisting centre for this new area and it will be equipped with an efficient plant. The Denver & Rio Grande has consented to repair the old siding to the Coronado and Midas and extend it to the Penrose shaft of the Down Town company. This will afford direct haulage for the Newell, which is within 50 ft. of the right-of-way. The Down Town Mines Co. has been seriously handicapped in ore-production during the past month because of the inability of the Colorado & Southern to handle the output. The small narrow-gauge engines are not equal to the task of switching 50 and 60-ton cars in stormy weather and the Penrose has been tied up for several days at a time.

PLATTEVILLE, WISCONSIN

BAD WEATHER CONDITIONS.—CAR SHORTAGE.—OUTPUT.

Zinc operators of the Wisconsin field began the current year under unsatisfactory market conditions, but with the hope that this drawback might be modified by heavy outputting. The stringency in the labor market had been overcome and the mines and plants were efficiently organized for a strong recovery of ore; unfortunately, however, a number of contingencies arose to defeat this effort. A scarcity of cars, made more manifest under the orders of the war board, existed all the month; about mid-month the field was visited by a howling blizzard that buried roads, plants, and railway tracks, bottling up the entire field most securely for a whole week, and on top of this came orders from the Washington administration for a five-day shut-down because of lack of fuel; this was religiously observed by every mining company. All the strenuous labor of digging out was nullified by a fourth severe snowstorm during the latter part of the month. This swept the field for three days, but the railway companies were better equipped to meet this last onslaught of the elements and less running time

was lost. Heavy snows were accompanied by extremely low temperatures and mill reservoirs and frozen intakes crippled many mining plants, interrupting working schedules. Power plants were shut-down through lack of fuel and patrons suffered until this deficiency was remedied. Operators faced the distressing situations gamely and working forces were treated with generosity in the payment of wages. The showing at the end of the month, both from the standpoint of production and deliveries, was better than expected and a reserve, estimated at more than 6000 tons of zinc concentrate, was carried over as well. Prices remained stationary all the month, the top grades calling for $62 per ton base with the range down to $52 on medium and second-grade ore. Refinery product was in better demand than other grades and sharp discrimination was shown in the offerings that applied to low-grade output with the result that shipments in this particular were greatly restricted and much low-grade ore was carried over. Independent low-grade producers, compelled to accept open market quotations, reduced working forces and in several instances suspended operations entirely for the time being. Unless immediate relief is afforded through advances in the price of zinc ore, it appears more than probable that little effort will be made to resume operations much before the return of spring weather among this class of mines.

The situation in the lead ore branch of the mining industry was much more encouraging, for prices advanced steadily all through the month until offerings reached $85 per ton for 80% ore. Producers have steadfastly maintained that no sales should be made below $90 per ton, and to this resolve they have been true, as shipments for the month will show.

Shippers of pyrite were encouraged to believe, through Washington reports that indicated the possibility of sulphuric acid supplies being commandeered, that better conditions would be ushered into this branch of the industry. Several of the larger refineries who carry a large reserve entered into long-term contracts just prior to the War and these have been at a great disadvantage on account of flat rates that afford little profit under the increased costs of supplies and labor. Much dissatisfaction exists and contracts are observed under a strict interpretation of the wording of such agreements, with the result that shipments are restricted and a reserve is held now in excess of 5000 tons.

Deliveries of zinc ore, lead ore, and pyrite, were made for January to refiners and smelters by districts as here shown:

District:	Zinc, lb.	Lead, lb.	Pyrite, lb.
Benton	16,828,000	206,000	1,716,000
Mifflin	4,948,000	80,000	.....
Galena	1,582,000	.....	.....
Linden	786,000	.....	1,200,000
Highland	720,000	.....	.....
Hazel Green	608,000	.....	.....
Platteville	398,000	.....	.....
Shullsburg	352,000	.....	.....
Dodgeville	252,000	.....	.....
Cuba City	.....	.....	1,840,000
Total	26,474,000	286,000	4,756,000

Shipments from refining plants, in the field, January 1 to 26 inclusive, were made as follows:

	Lb.
Mineral Point Zinc Co.	5,846,000
Wisconsin Zinc Co.	2,854,000
National Separator Works	2,432,000
Linden Zinc Co.	446,000
Benton Roasters Co.	338,000
Total	11,916,000

The gross recovery of mine run for the month amounted to 13,928 short tons; net deliveries to smelters 9274 tons; a poor showing when compared with a similar period in 1917.

Sales and distributions were made to buyers as reported: Mineral Point Zinc Co., 4427 tons; Wisconsin Zinc Co., 3123 tons; National Separators, 2992 tons; Grasselli Chemical Co., 2942 tons; Linden Zinc Co., 922 tons; American Metal Co., 828 tons; Illinois Zinc Co., 738 tons; American Zinc Co., 466 tons; Benton Roasters Co., 175 tons; Matthieson & Hegeler Zinc Co., 160 tons; American Steel & Wire Co., 100 tons; Lanyon Zinc Co., 76 tons.

MAMMOTH, UTAH

TINTIC STANDARD.—PLUTUS.—CHIEF CON.—TINTIC DRAIN TUNNEL.—KNIGHT DRAIN TUNNEL.

Shipments of ore from the mines of the Tintic district during the month of January totaled 671 carloads, estimated at 30,000 tons in weight and $900,000 in value. This production is compared with 709 cars in December, 896 cars in November, and 676 cars in October. The shipments in January 1917 amounted to 802 cars, showing a decrease this year of 125 cars; this is due to the fact that a year ago there were no restrictions by the smelters.——The present development on the 1260-ft. level of the Tintic Standard property has reached an interesting stage. Lately a drift was sent out 200 ft. to the east of the new shaft which cut ore. To the north of the shaft on the 1260-ft. level a drift has followed the main ore-channel for a distance of 100 ft. Here it takes half a dozen sets to span the face of the ore opened to date, and most of this breast is shipping quality. Some high-grade ore has been opened from the 340-ft. drift that connects the new shaft with the old stope on the 1260-ft. level. To the north and about half-way between the shaft and the stope some ore was struck, carrying 25% copper and 200 to 300 oz. of silver. The orebody is 40 ft. wide.——Four headings are now being driven into the big body of quartz, recently uncovered in that part of the Plutus ground which is being developed through the Victoria property. It will be remembered that a drift was run into the Plutus from the 1200-ft. level of the Victoria and, while the work has for some time been conducted under the most favorable conditions, the showing has never been as good as it is at this time. That the ore will be found in this quartz is the opinion of Cecil Fitch of the Chief Consolidated and, in order that no time shall be lost in bringing the Plutus into the productive stage, drifts are being driven in two directions and at the same time sinking and raising is in progress. Officials of the Chief Con. company have for several years been confident that one or more important ore-zones traverse the Plutus holdings and disclosures of the past year, particularly the finding of this body of quartz, have given them even greater confidence in the ground adjoining their own mine.——During the past year the Chief Con. did 15,430 ft. of development, including drifts 13,592 ft., raises 1626 ft., and winzes 212 ft. In addition considerable development was done at the Pinion Peak, or Homansville, section of the Chief's holdings, as well as extensive work on the Plutus company's ground. The total shipments from the mine amounted to 59,950 dry tons, which yielded, after payment of smelting, transportation, and sampling, $1,554,714. The metal contents were: gold 9175 oz., silver 1,534,907 oz., lead 10,780,540 lb., and zinc 600,236 lb. The average gross value of ore was $40.12 per ton and the average net value $25.93. The net profit was $427,637.24.——A. L. Hartley and J. M. McShane, both of Silver City, have sold the Hetty Green and the Look Out claims to the Tintic Drain Tunnel Co. and Mr. Hartley also has conveyed to the same company the Josephite, Maid of Erin, Daisy, Summit, Grand View, Independence, May Flower, Ophir, Garden City, and Goshen claims. A part of this mineral ground will be

cut by the new drain tunnel and the remainder is in close proximity to the proposed line of the tunnel.——The Knight Drain Tunnel Co. is being hindered in its operations by delay in receipt of a set of transformers that were ordered several months ago. Work has reached a point where the electrical power is badly needed.——In an action filed in the Federal court recently, the Utah Consolidated Mining Co. seeks an injunction against the Tintic Mining & Development Co. restraining the latter from taking ore from the property of the plaintiff, situated in the Eureka district, and demanding an accounting for ore alleged to have been extracted. It is claimed that the Tintic company has extended the workings from its own mines into those of the plaintiff, and that ore to the value of $300,000 has been extracted therefrom.——Work at the Utah Consolidated is progressing favorably. The copper ore it is now mining is low-grade and with the higher operating costs due to wage advances and high prices for supplies this ore will not yield a large profit on a 23½c. metal-market. As the development in the lead area of its property is understood to have been satisfactory, however, it would seem that the greater portion of its profit in future will accrue from shipments of lead ore.

HOUGHTON, MICHIGAN

QUINCY.—CALUMET & HECLA.—WHITE PINE.—SENECA.—MICHIGAN.

The No. 2 shaft at the Quincy is hoisting copper ore from a depth of 7800 ft. One day this week when the miners started for this depth the thermometer stood at 28° below zero, with an 80-mile blizzard right from the Canadian shore coming across Lake Superior. When these miners reached their working places the temperature was so high that they worked stripped to the skin and the sweat ran off their healthy bodies. The 'warm' mines are popular here in the winter time. Quincy now has under construction at the Nordberg shops, at Milwaukee, a hoisting plant that will carry copper ore from a depth of 10,000 ft. This is surpassed by few plants in the world as far as one long continuous haul is concerned. Ten years ago, when it was suggested that the time would come when copper ore could profitably be mined from a depth of two miles underground, it was considered preposterous. The writer remembers when one mile was considered out of all reason. Then came the Red Jacket shaft of the Calumet & Hecla and the Tamarack No. 5, both perpendicular shafts that went down a mile. These perpendicular shafts today are beating all records for speed in handling tonnages; and at the bottom of the vertical shaft at the Calumet & Hecla there is another hoisting plant, practically a duplicate of the surface plant, that handles tonnages from still greater distance on the dip of the vein.——The contract for the new Quincy hoist was let last spring and is to be delivered next summer. It will replace the present hoisting plant at No. 2 shaft, and the plant at the latter then will be removed to the Mesnard shaft No. 8, which is being gradually sunk deeper though already up to the capacity of the shaft hoist operating there. The hoist in use at Mesnard will go to the Pontiac, which branch of the Quincy has not been operating since the strike.

The Calumet & Hecla is operating only two shafts on the Tamarack property, No. 5 and No. 3, the latter formerly known as the North Tamarack. Nothing but conglomerate ore is coming from these shafts. Plans for greater economies in the matter of tramming and hoisting and the elimination of long hauls are being planned to handle this tonnage.——The recent fire damage is being repaired rapidly and shaft-sinking at the Seneca will start soon. The frame construction work is already well advanced.——The vertical No. 2 shaft at White Pine is getting into mineralized zone. The ore tonnage last month was 20,000, a substantial increase over previous records.

TONOPAH, NEVADA

TONOPAH MINING.—TONOPAH EXTENSION.—TONOPAH BELMONT.—WEST END.—CASH BOY.

At the Silver Top shaft of the Tonopah Mining Co. 31 ft. of development has been done and 56 ft. at the Sandgrass. Stoping on the Beta Fault vein on the 540-ft. level continues in good ore. On the 600-ft. level of the Mizpah stoping is being advanced on a 4-ft. face on the Mizpah vein. On the 1140-ft. level the Upper Sandgrass vein is 7 ft. wide. The shipments to the Millers plant amounted to 3250 tons.——The Tonopah Extension Mining Co. milled 9058 tons of ore during December, resulting in a net profit of $18,000, which shows a decided increase over the net earnings of the preceding three months. At the No. 2 shaft 64 ft. of development has been done and 151 ft. at the Victor. At the No. 2 shaft on the 850-ft. level raise No. 815 made a connection with the stope above. On the 1260-ft. level raise No. 469 shows a 3-ft. face of ore. On the 1350-ft. level raise No. 573 was advanced 17 ft. on a 3-ft. face of ore. The intermediate drift from winze No. 1501 on the 1540-ft. level of the Victor continues on a 5-ft. face of ore. On the 1680-ft. level west drift No. 1600 advanced 28 ft. on a 2-ft. face of ore, while east drift No. 1601 advanced 24 ft. on a face of equal size. West drift 1602 on the O.K. vein shows a 5-ft. face of ore. The foot-wall branch of the Merger vein, called the Victor vein, is being developed by drifts to the east and west. The production last week was 2380 tons.——On the 700-ft. level of the Tonopah Belmont Development Co. east drift No. 721 on the Shoestring vein shows 1½ ft. of good ore. Raise No. 19 on the 800-ft. level shows 6 ft. of good ore on the South vein, while raise No. 20 on the same vein has a 6-ft. face of good ore. West drift No. 9026 on the Occidental vein shows a 3-ft. face of medium-grade ore. On the 1100-ft. level east drift No. 1142 on the Western vein shows a 2-ft. face of medium-grade ore. Last week's production was 2557 tons.——The West End Consolidated Mining Co. declared a dividend of 10c. per share payable March 1, the books closing February 16. The amount of the dividend is $178,849, making the total dividend to date $994,243. The West End mill shipped 32 bars of bullion valued at $64,000. At the Ohio winze No. 534 is progressing in low-grade ore, and drift No. 539 shows a full face of low-grade ore. On the 555-ft. level cross-cut No. 3 has been discontinued and raise No. 7 has been started to develop the vein. Stope No. 3 continues to produce good ore. Cross-cut No. 601, which is the new level started from raise No. 814, shows a face of fair ore. At the West End cross-cut No. 809 is in low-grade ore. The output last week was 1140 tons.

The MacNamara Mining Co. shipped 10,395 oz. of bullion valued at $11,434. West cross-cut No. 700 advanced 58 ft. The output last week was 704 tons.——The recent strike made in the Cash Boy continues to show good ore on further development. The vein was cut in the south cross-cut from the winze on the 1600-ft. level. The vein has an easterly and westerly strike and a dip to the north, which coincides with the strike and dip of the veins in the Victor section of the Tonopah Extension Mining Co. A drift to the west has been started showing 9 ft. of ore assaying $77 per ton. The east drift shows a full face of ore averaging $43 per ton. The production last week was 165 tons.——On the 2nd level of the Wandering Boy shaft of the Jim Butler Tonopah Mining Co. raise No. 372 made a connection and work has been resumed in west drift No. 370. At the Desert Queen shaft raise No. 657 cut the South vein exposing 3 ft. of ore. The production last week was 406 tons.——An intermediate drift has been started from raise No. 815 at the Monarch Pittsburg Mining Co. The face of the drift shows 3 ft. of quartz.——The miscellaneous production was 82 tons, making the week's production at Tonopah 10,738 tons with a gross value of $132,546.

THE MINING SUMMARY

ARIZONA

COCHISE COUNTY

(Special Correspondence.)—Another strike of good copper ore has been made at the Gold Ridge at Dos Cabezas. H. C. Kimball has left for California to negotiate for the new concentrating plant the company expects to erect shortly. The first unit will be 100 tons per day. There are two veins on this property each averaging 5 ft. and assaying 2.76% copper, $3 gold, 13 oz. silver, and 11% lead.——A cyanide-mill of 100 tons capacity is being erected by A. Y. Smith to treat the tailing of the Commonwealth mine, which closed-down last fall. There is sufficient tailing to operate the mill for two years. The Middlemarch Mining Co., seven miles west of Pearce, has recently completed a new flotation plant. The Central Butte company is pushing development.

Bisbee, February 2.

GILA COUNTY

(Special Correspondence.)—A strike of ore carrying 28% lead besides gold and silver has been made by the Ray Silver-Lead Co., at Ray.

Ray, February 1.

MOHAVE COUNTY

(Special Correspondence.)—The station on the 250-ft. level of the Leviathan mine has been timbered and cross-cutting toward the Copper Wonder claim to the west is under way.——The Tom Reed Gold Mines Co. contemplates the further development of the Gray Eagle vein by 250 ft. of cross-cutting and 500 ft. of driving at the 535-ft. level of the Aztec mine. All ore from the Gray Eagle will then be trammed to the Aztec shaft and sent to the mill by aerial tramway.——Mr. Goldsworthy, the superintendent, announced that the cross-cut on the 550-ft. level of the United Northern has cut what appears to be the true orebody.

Kingman, February 4.

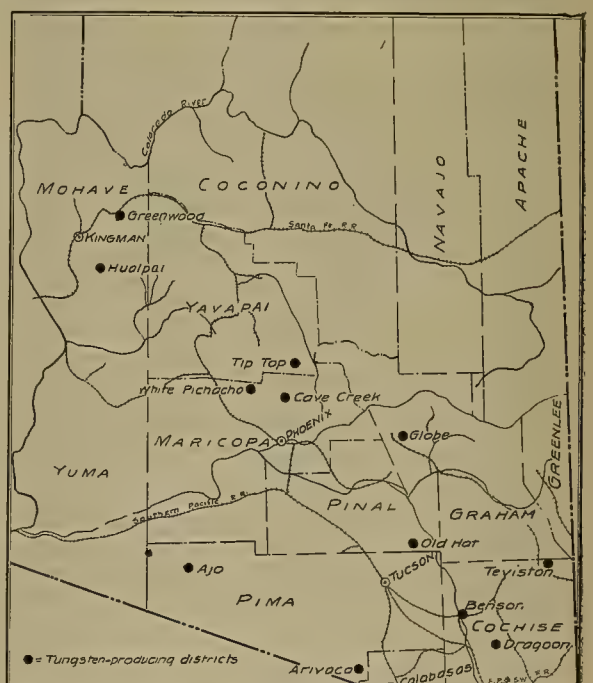
PIMA COUNTY

(Special Correspondence.)—A Bureau of Mines for Pima county has been formed and is to be under the jurisdiction of the Tucson Chamber of Commerce. The board of directors comprises most of the prominent and representative mining men from the operating districts of Pima county.——The Mineral Hill Consolidated, one of the oldest properties in the San Xavier district, has ceased shipping and has turned all energies toward development. The main shaft is down 500 ft. The ore that is being blocked-out assays 4% copper. A new duplex electrical pump capable of handling 250 gal. per minute is being placed; the power will be supplied by a 75-hp. semi-Diesel Y-type engine and 50-kw. generator.——Considerable work has been done on the Wakefield-Lambing group of claims, recently acquired by the Reineger-Freeman Mines Co. The new company has installed a power-plant, and a new double-compartment shaft is being sunk which, when completed, will be 500 ft. deep. An incline shaft is being sunk 200 yards to the north. Development work is also being done to the east of Helmet Peak, from where copper ore is being shipped. The ore from this property is lead and zinc carrying silver, and passing into copper at depth.——The San Xavier Extension's new shaft is now down about 120 ft., the old shaft being 275 ft. deep. At the new shaft a 25-hp. hoist, compressor, and power plant have been added.——The Alpha property has struck high-grade copper ore, one car having already been shipped.——The Hecla Arizona's shaft is now down 200 ft.——The San Xavier mine, owned by the New Jersey Zinc Co., is shut-down, being held as a reserve by the parent company.——The Plumed Knight is shipping ore to Tucson daily.

Tucson, February 2.

YAVAPAI COUNTY

(Special Correspondence.)—C. Hoyt of the Verde district has brought suit in the supreme court of New York to recover from G. G. Rice $13,450 which he alleges is due on a promissory note given in part payment for the Monster Chief property.——It is reported that a deposit of potash assaying 3.30% potassium has been discovered four miles west of Jerome.——It is announced by J. C. Haslet that certain interests of the United Verde Copper Co. contemplate entering the Chino Valley oilfield.



MAP OF ARIZONA

Prescott, February 1.

CALIFORNIA

ALPINE COUNTY

(Special Correspondence.)—A new strike of a large deposit of silver-copper-gold ore is reported to have been made re-

cently in the Curtz mine, just north-east of the Cryptic-Crater mines, in this county. The Curtz mine was taken over last December by William and Edmund Nelson and others. Three shifts of miners have been kept at work in the mine by the new owners.

Markleeville, February 7.

ELDORADO COUNTY

(Special Correspondence.)—The mill formerly operated on gold ore from the Buzzard mine is being overhauled and provided with concentrators for the treatment of chrome ore from the Pilot Hill and Salmon Falls districts. F. Gurney is directing the work and the plant will soon go into action. A large tonnage of chrome has been opened around Negro hill, much of the material being of fair milling grade. Prospecting is active at numerous points.——Work has begun at the Teddy Bear, near Nashville, under the management of J. W. Cover. ——The mill at the Montezuma, in the Nashville district, is being repaired and will be placed in commission soon. This property has been undergoing vigorous development for three years and a large tonnage of milling ore is reported. The shaft is 1000 ft. deep. J. C. Heald is manager and owner.——From the J. B. Williams mine at Shingle Springs 22 tons of copper ore was shipped last week. Opening of new ground is proceeding and the owner expects to ship steadily this summer.

Placerville, February 12.

INYO COUNTY

(Special Correspondence.)—The mills of the Round Valley Tungsten, Standard Mines, and Tungsten Mines companies are operating steadily and treating about 450 tons of ore daily. The combined payroll aggregates $30,000 per month. The three mines are looking well; late developments prove the orebodies more extensive and of higher grade than originally believed. The Beauregarde group of tungsten claims on Pine creek, in the White mountains, has been acquired by engineers reported to be connected with the E. J. Longyear Co. of Minneapolis. A survey for an electric power line has been completed and construction of a road is progressing. It has been decided to erect a 150-ton mill. A. B. Carpenter and E. E. McIntyre are directing operations. Cooper Shapley is manager.——The Black Hawk gold mine, now under control of the Yellow Aster Co., is developing favorably. New drills have exposed an ore-shoot 14 in. wide, and considerable free-gold quartz is reported in sight.——Henry Bopp is extracting gold ore from his property on the Garlock slope of the Rand mountains, 10 miles west of Randsburg. Recent milling of seven tons yielded $800.——Mining continues active in the Keeler-Darwin field. The Cerro Gordo, Darwin Development, Santa Rosa, and other companies are operating steadily, and heavy shipments of silver-lead and zinc ores are going out from the Cerro Gordo and nearby properties tributary to Keeler.

Bishop, February 12.

PLUMAS COUNTY

(Special Correspondence.)—News has been received here that the Anaconda Copper Co. has arranged to take over the interest of the Plumas Copper Co. in the Walker mine for $500,000. This would give the Anaconda full control of the property, which is about 25 miles from Portola. The mine for several months has been developed under direction of the International Copper Co., and concentrate from the flotation plant has been shipped to the Tooele smelter. The new shaft is 450 ft. deep, and is reported to be in ore assaying upward of 8% copper and $3 in gold and silver. The main ore-channel has been traced for 1000 ft. and late developments have been encouraging. The improved flotation plant has a daily capacity of 160 tons. All equipment is electrically driven. The International holds bonds and options on other properties in the district, and excellent ore is reported under development in several claims.——The Engels Copper Co. is preparing for development of the Superior mine on a largely increased scale. This property has been extensively prospected with drills and high-grade orebodies demonstrated at depth. In the upper workings a good tonnage of profitable ore has been exposed. A heavy tonnage of ore from the Engels mine is going to the enlarged flotation plant, which is being continually improved. Before the end of 1918 the management expects to place the Engels group among the largest copper producers of California.——Many small properties near Keddie, at points between the Engels and Walker mines, and in Genesse valley are active.

Portola, February 9.

SHASTA COUNTY

Mrs. Rhoda B. Menzer has sold her 1042-acre farm, near Redding, to the American Dredging Co. for $80,000. The last payment is to be made within a year from this month. The American Dredging Co. was formerly the Oro Electric Corporation. The farm has been prospected twice with Keystone drills. The first company that prospected it turned it down, but the second one has accepted it. It is estimated that 650 acres will pay well to dredge for gold. The ranch is at the mounth of Middle creek, which was famous in early days for placer-gold mining. Even the river adjoining the ranch has been dredged for gold at a profit, and now the purchasing company has determined that the bench land above the river shall be worked.

COLORADO

TELLER COUNTY

(Special Correspondence.)—Owing to the car shortage the production of the Cripple Creek district for the opening month of 1918 totalled only 92,373 tons of ore, having an average value of $10 and gross bullion value of $925,430.——The treatment reported at the several plants was as follows: Golden Cycle 24,000 tons, $480,000; Portland 9300 tons, $190,650; Smelters 2500 tons, $137,500; Independence Mill 37,000 tons, $76,960; Victor Mill 19,573 tons, $40,320.——The January dividends totalled $273,500 and were paid as follows: Cresson Consolidated 10c., $122,000; Golden Cycle 3c., $45,000; Portland Gold 3c., (quarterly) $90,000; Granite Gold 2c., (bi-monthly) $16,500. ——Six additional leasing companies, operating properties of the Stratton company, have entered the producing class since January 1. These are the Patterson-Bradley Leasing Co., Orpha May & Blocks, the Unity Leasing Co., Oscar Simms & Co., Layman & Upton, Vernon Peiffer & Co., and Green & Clifford.——The January output from the Stratton estate properties totalled 20 cars or about 700 tons, ranging from $5 for the dump ore to as high as $950 per ton.——The directors and officials of the Golden Cycle M. & R. Co., headed by A. E. Carlton as president, were re-elected at the annual meeting held at Colorado Springs on January 31. Stockholders will be paid the regular monthly dividend of 3c. per share, $45,000, on February 10.——The Cresson Consolidated will pay its regular monthly dividend of 10c. per share, $122,000, on February 10. It is officially announced that another rich orebody, with grab samples running from $105 to $300 per ton, has been opened in virgin ground on the 1000-ft. level. The orebody, believed to be the extension of the 1300 and 1400-ft. level shoots, opened last summer, is reported 30 ft. wide and extending over a length of 1000 ft.——The January output of the Acacia G. M. Co. was light, between 175 and 200 tons of 1-oz. ore.——Leases running for five-year terms have been issued to J. R. Woolwine and H. Kruse on the Mollie Bell and Kitty Wells, on Carbonate hill, directly north of Cripple Creek, by George K. Blaser.—— The new rate for treating low-grade ores at the Independence mill is as follows: Ore running $3 per ton, $2; from $3 to $3.50, $2.25; $3.50 to $4, $2.50; $4 to $4.50, $2.60; $4.50 to $5, $2.75 per ton. The Golden Cycle company, it is reported, will

meet these charges.——The Roosevelt tunnel was advanced 144 ft. and the Cresson cross-cut from the tunnel-level 105 ft., making a total of 249 ft. during January. The flow from the tunnel has fallen to 3720 gallons per minute.

Cripple Creek, February 8.

IDAHO

BONNER COUNTY

The adit at the Armstead Mines Co., in the driving of which several excellent records for speed were made, reached its objective on January 30, cutting the vein at 3505 ft. from the portal and at a vertical depth of 1600 feet. The adit has passed through five feet of concentrating ore, assaying 25 oz. in silver per ton, and has not yet reached the foot-wall.

MONTANA

LEWIS AND CLARK COUNTY

In the Grass Valley district the Helena Mining Bureau has surpassed its former record by sending to the smelter nine carloads of ore during January. A new compressor has been added to the mechanical department, making two in operation. Ore is being stoped from a shoot 200 ft. long in the 300-ft. level. The Rock Rose has uncovered two feet of galena and carbonate ore at 200 ft. and has other ore on the 300-ft. level that is being mined and shipped.——In the Scratch Gravel hills the Thomas Cruse Development Co. has found a strong shoot of ore at a depth of 640 ft. on the incline, and 1000 ft. east of the shaft. The ore, which is quartz, carries considerable silver and lead in addition to the gold content.——The Shannon shaft at Marysville has been completed to the 650-ft. level, making an additional 150 ft. The ore-shoot is west of the shaft and a drift will be run toward it during the month. The ore from the Shannon goes to the mill at Gloster, as also does the output of the Piegan-Gloster. The Barnes-King company is the owner and operator.——The St. Louis Mining & Milling Co. is milling ore that was mined from the Blue Bird-Hickey adit while the property was being explored by the Marysville Gold Syndicate.——In Lump gulch the Amalgamated Silver Mines Co. has deepened its shaft to 230 ft. and will continue to the 250-ft. level before driving.——The Economy company is sinking a winze on a rich shoot of ore at the 300-ft. level in Mitchell gulch.

SILVER BOW COUNTY

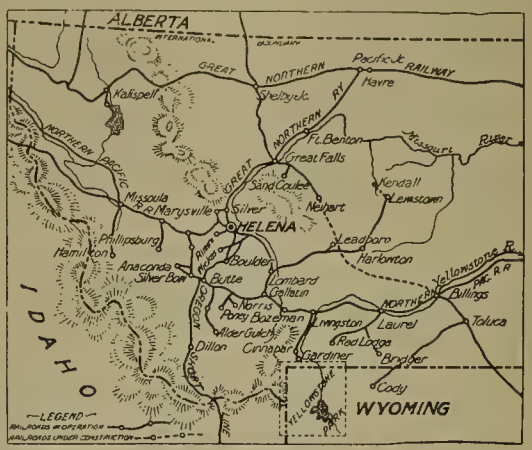
(Special Correspondence.)—The annual meeting of the Montana Section of A. I. M. E. was held at the Silver Bow Club, Butte, February 1. After an excellent dinner, an election was held which resulted in the following officers for the ensuing year: N. B. Braly, chairman; B. N. Dunshee, vice-chairman; E. B. Young, secretary-treasurer; C. D. Demond, F. W. Bacon, executive committee. An excellent and varied technical programme was the feature of the session. C. H. Clapp spoke at length on a comparison of the contact deposits of Vancouver and adjacent islands with those of Arizona. With suggestive generalizations he showed that as striking differences exist in the contact deposits as in the geologic structure and physiography of the two regions. C. D. Demond discussed the efficiency and design of hydraulic classifiers, and F. W. Bacorn shaft-sinking, while James R. Evans, who has returned recently from Africa, entertained the meeting by an interesting account of diamond mining and elephant hunting in the Belgian Congo.

Butte, February 4.

(Special Correspondence.)—The 2200-ft. level on the Adirondack vein at the North Butte has been driven 88 ft., 66 ft. of which was in ore averaging 7.5 ft. wide and assaying 4.8% copper and 2.8 oz. silver per ton.——The 2400-ft. level on the South Croesus vein has been advanced 110 ft., 86 ft. of which was in ore averaging 4 ft. and assaying 2.5% copper and 3 oz. silver per ton. The 2600-ft. level on the Snowball vein has been advanced 49 ft., showing ore of an average width of 4 ft., assaying 4.5% copper and 7 oz. silver per ton. The 2400-ft. level on the North Berlin vein has been extended 58 ft., showing ore of an average width of 4 ft., assaying 5.1% copper and 6.1 oz. silver per ton. The following development work was done during the quarter: cross-cuts 4 ft., drifts 305 ft., raises 338 ft., total 647 ft.——The Sarsfield shaft on the East Side properties is now 495 ft. below the collar, and will be sunk another 205 ft. before levels and cross-cuts are driven; a 200-hp. compressor will be installed to cope with the excessive flow of water. During the quarter 31,829 tons of ore and three tons of copper precipitate were shipped.

During January the East Butte Copper Co. produced 2,574,140 lb. of copper at its Pittsmont smelting plant, while in December only 2,500,000 lb. was produced. In January the silver production amounted to 82,175 oz., against 55,000 oz. for December, a gain of 27,175 oz.——A large increase in output has been shown during January by the Anaconda Copper Mining Co., which produced 24,900,000 lb. of copper, as compared with 22,500,000 lb. in December, an increase of 2,400,000 lb.,, and 4,500,000 lb. of zinc. These figures show that the company is rapidly approaching its normal production, and when the additional roasters are in operation at the Great Falls plant, the electrolytic plant will give the Anaconda company an estimated monthly zinc production of between 6,500,000 and 7,000,000 lb. An average day's hoisting of copper and zinc ore is said to be about 18,000 tons. On February 2, the Anaconda company handled 1000 tons of ore from the North Butte company, this being the largest daily tonnage from that company since the fire, last June.——It is expected that the Anaconda will resume the purchasing of zinc ores from custom shippers shortly, and it is rumored that it will increase the rate of payment from one-half to one and one-half cents per pound for the zinc in the ore. This was the original price set, but was cut when the slump came and the disposal of the finished product became difficult.——The Butte & Superior Mining Co. produced 14,600,000 lb. of zinc, in the form of concentrate, during January. In December the zinc output was 13,400,000 lb., showing an increase of 1,200,000 lb.——The silver production in January was 265,000 oz. as against 250,000 oz. in December. The total amount of ore mined in January was 47,000 tons, while in December only 43,000 tons was hoisted.——The concentrate tonnage for January was 14,600 tons, as against 13,400 tons in December.

Butte, February 9.



PART OF MONTANA

NEVADA

ESMERALDA COUNTY

(Special Correspondence.)—Ore of shipping grade has been uncovered at a depth of 400 ft. in the Red Hill-Florence mine. The discovery was made in a drift extending from the raise driven from the 500-ft. level to prospect territory adjacent to the old Rogers-Syndicate lease on the Florence. Joseph B. Kendall, the manager, expects to start shipment soon. Retimbering of the main shaft from the 500 to the 600-ft. level has been completed, and the 600-ft. station placed in shape for comprehensive work. Drifts will be extended to a shoot formerly worked below the 500-ft. level of the Florence. The Red Hill-Florence is a consolidation of the old Red Hill and Florence Extension mines.——The Atlanta company has completed the station on the 1900-ft. level and started a cross-cut east to intersect the main vein. This work is in the shale, but the cross-cut is expected to enter the granitic quartz within a short distance. A second winze has been started from the 1750-ft. level to explore the hanging-wall section of the Atlanta vein. The water-flow has decreased in the first winze and mining is proceeding more rapidly.——The Great Bend is shipping ore averaging $44 per ton in gold, and the eastern workings have been connected on the 300-ft. level with the Lockhart shaft. This is being unwatered, preliminary to the vigorous prospecting of a promising area.——It is reported developments will be resumed at the Lone Star.

Goldfield, February 9.

MEXICO

JALISCO

The cyanide mill at the El Favor mine in the Hostotipaquillo district was burned by bandits on September 22, but the news has only recently come to hand. The damage was confined mainly to the stamp-batteries. The mill contained 35 stamps, and has a capacity of 250 tons per day. It is to be re-built at once by the Makeever brothers, who are the controlling owners of this property. James H. Nelson is resident manager. The mine is 1000 ft. deep and is said to be making a handsome showing, the lode being 40 to 50 ft. wide and averaging 750 gm. silver per metric ton. In the same district is the Cinco Minas property, which is making handsome profits under the management of Frank Oldfield. The mine is 1300 ft. deep, and shows 50 ft. of lode, of which 20 ft. assays a kilogramme of silver per metric ton. The mill contains 50 stamps and the machinery required for cyanidation. It is said to be the best designed mill in Mexico. Its present capacity is 400 tons per day, but this is to be increased to 600 tons per day forthwith.

NUEVO LEON

(Special Correspondent.)—The Mexican government will impose heavy financial penalty upon all mine-owners who are now delinquent or may become delinquent in the payment of mining taxes, according to official announcement received here by American and other mining men. The notice reads: "The treasury department of the Mexican government has ordered that mining taxes shall be collected from January to April, as follows: For fiscal year 1916-1917, with fine of 100% of the total amount of the taxes; for first third of the fiscal year 1917-1918, with fine of 75%; second and third third of 1917-1918, with fine of 50%; first third of 1918 without fine if paid in January or February, and with fine of 25% if paid in March or April."

Monterrey, January 29.

PHILIPPINE ISLANDS

The Colorado Mining Co. is re-constructing its cyanide plant at Aroroy; ball-mills will replace the old 20-stamp mill. J. S. Colbath is manager of the mine and E. H. Clausen is in charge of the mill-construction.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

W. A. Prichard is returning to Pato, Colombia.

Rolla E. Clapp has gone from San Francisco to Boston.

C. S. Herzig has moved from Salt Lake City to 27 William street, New York.

D. M. Folsom has been appointed petroleum administrator for the Pacific Coast region.

A. Angus has been appointed manager of the Tough Oakes mine, at Kirkland Lake, Ontario.

Douglas Muir passed through San Francisco on his way from Austin, Nevada, to Pasadena, California.

R. C. Warriner has resigned as consulting engineer to the Crown Mines in order to join the Air Service of the British army.

M. M. Makeever, of Boston, and L. Bradbury, of Los Angeles, have returned from Mexico to San Francisco, on their way home.

Falkenburg & Laucks has ceased to exist as a firm, being replaced by Falkenburg & Co., assayers, at Seattle, Washington.

P. S. Couldrey, formerly superintendent of the Cerro de Pasco mine, in Peru, is now serving with the Royal Engineers in England.

G. J. Steele, sergeant, is with the British mission that is instructing American soldiers in gas warfare. He is not in the Military Police.

Cedric Sheerer, Lieutenant, of Tucson, Arizona, was married on February 5 to Miss Pauline de Brutz Justice, of Berkeley, California.

Arthur E. G. Collins, son of George E. Collins, of Denver, has been awarded the Military Cross for "great gallantry and fine qualities of leadership and organization under fire," while serving as lieutenant in the Royal Engineers near Havrincourt, in France.

G. H. Clevenger has resigned as Research Professor of Metallurgy in Stanford University and is now engaged in directing the co-operative experimental work that is being done by the U. S. Bureau of Mines, Netherlands East India Government, and Research Corporation of New York.

Obituary

William Stanley, one of the pioneers of the Klondyke, died on February 6 at Pomona, California.

Angus M. Hardie, the discoverer of gold on the Fraser river, B. C., and later identified with mining in Eldorado county, California, died at San Luis Obispo, California, on February 6.

Auguste Mathez died at Denver on February 4. He was born at Brooklyn, New York, in 1856 and graduated from the Columbia School of Mines in 1879. His first work as mining engineer was in California and Nevada, then in Gilpin county, Colorado, with headquarters at Denver. He was at Dawson in the early days of the Klondyke excitement and was examining mines for the Guggenheims in China at the time of the Boxer rebellion. He traveled widely in the exercise of his profession, going to Australia, Mexico, and Central America. He was considered a man of good judgment in the appraisal of mines. Kindly in disposition and genial in temper, he won friends easily wherever he went. He is survived by his son, Forrest Mathez, who is engaged in mining, and by a daughter Claire, the wife of James Arkell, who is operating mines in Mexico.

THE METAL MARKET



METAL PRICES

San Francisco, February 11

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.95
Antimony, cents per pound	16.00
Antimony (wholesale), cents per pound	14.00
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67½
Pig-lead, cents per pound	7.25— 8.50
Platinum, soft and hard metal, respectively, per ounce	108— 116
Quicksilver, per flask of 75 lb	$125
Spelter, cents per pound	10.00
Zinc-dust, cents per pound	20.00

ORE PRICES

San Francisco, February 11

Antimony, 45% metal, per unit	$1.00
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.85— 1.00
Magnesite, crude, per ton	$8.00—10.00

There is little demand for either calcined or crude magnesite.

Manganese: The Eastern manganese market continues fairly strong with $1 per unit Mn quoted on the basis of 48% material.

Tungsten, 60% WO_3, per unit	26.00

Tungsten ore remains firm.

Molybdenite, per unit MoS_2	$40.00—45.00

EASTERN METAL MARKET

(By wire from New York)

February 12.—Copper is inactive at 23.50c. all week. Lead is quiet and firm at 7c. all week. Zinc is dull and steady at 8c. all week. Platinum is unchanged at $108 for soft metal and $116 for hard.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Feb.	6	Jan. 1	86.62
"	7	" 8	88.66
"	8	" 15	90.04
"	9	" 22	89.29
"	10 Sunday	" 29	87.35
"	11 Holiday	Feb. 5	86.62
"	12 Holiday	" 12	85.93

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	....	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

Samuel Montagu & Co. says: The Transvaal gold output for December 1917 amounted to £3,068,639 as compared with £3,289,705 for December 1916 and £3,070,426 for November 1917. The total output for 1917 amounted to £38,323,921 as compared with £39,484,934 for 1916, a decrease of £1,161,013.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Feb.	6	Jan. 1	7.87
"	7	" 8	7.87
"	8	" 15	7.87
"	9	" 22	7.87
"	10 Sunday	" 29	7.87
"	11 Holiday	Feb. 5	7.87
"	12 Holiday	" 12	8.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	....	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

The Government is buying and using large quantities of various grades of zinc designated as grade A, grade B, and grade C. There is considerable confusion in the mind of the general public as to what distinguishes these various grades. The following tables, compiled from the government specifications, throws light on the subject and gives the chemical requirements:

	Grade A %	Grade B %	Grade C %
Zinc, minimum	99.85	99.35	98.00
Cadmium, maximum	0.05	0.50	0.75
Iron, maximum	0.03	0.03	0.08
Lead, maximum	0.07	0.20	1.00
Sum of cadmium, iron, and lead, max.	0.10	0.50	1.50
Aluminum, maximum	none	none	trace
Other elements (tin, arsenic, sulphur, antimony, etc.)	none	trace	trace

Grade A is the purest. Only virgin spelter of zinc, that is, spelter made from ore or similar raw material by a process of reduction or distillation and not produced from re-worked metal, shall be furnished for grade A. High-grade zinc shall be furnished for grade B; this may include refined zinc, that is, metal resulting from short ends, but not scrap metal. Grade C is nearly the same as prime Western zinc, but is regarded as a little better.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Feb.	6	Jan. 1	23.50
"	7	" 8	23.50
"	8	" 15	23.50
"	9	" 22	23.50
"	10 Sunday	" 29	23.50
"	11 Holiday	Feb. 5	23.50
"	12 Holiday	" 12	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	....	Aug.	27.03	27.42	....
Mch.	26.65	36.00	....	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Feb.	6	Jan. 1	6.50
"	7	" 8	6.65
"	8	" 15	6.75
"	9	" 22	6.98
"	10 Sunday	" 29	7.00
"	11 Holiday	Feb. 5	7.00
"	12 Holiday	" 12	7.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	....	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Week ending	
Jan.	15	Jan. 29	125.00
"	22	Feb. 5	125.00
		" 12	125.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	.....
Feb.	295.00	126.25	.....	Aug.	74.50	115.00	.....
Mch.	219.00	113.75	.....	Sept.	75.00	112.00	.....
Apr.	141.60	114.50	.....	Oct.	78.20	102.00	.....
May	90.00	104.00	.....	Nov.	79.50	102.50	.....
June	74.70	85.50	.....	Dec.	80.00	117.42	.....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	....	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

ORES

Tungsten: There has been 100 tons of wolframite offered in this market at $26.50 per unit, but no takers so far reported. A fair business has been done recently at the usual price-ranges of $20 to $26, scheelite commanding the highest prices. Railroad congestion is interfering with shipments. Ferro-tungsten is quoted at $2.35 per lb. of contained tungsten.

Molybdenum and antimony: Transactions of fair volume are reported in molybdenum concentrate at $2.15 per lb. of MoS_2 in 85 to 90% material. Antimony ore is nominal at former levels of about $1.75 per unit.

The American Smelting & Refining Co. will soon have materially increased its Mexican operations through resumption of activity in Chihuahua. In that State the Guggenheims have been closed-down for the past four years, both in mining and smelting there the company has its largest and most important Mexican plants.

It is understood that the United States government will soon send a new consul to that district, a man who has been in the consular service for some years and who is well conversant with conditions among Latin-Americans. An engineering and construction force is expected to leave for Chihuahua shortly to put into condition the Smelting company's plants.

Eastern Metal Market

New York, February 6.

'Coalless' Monday was again rigidly observed this week, and no business was done in metals, business houses and the New York Metal Exchange all being closed. The expectation of its being the last day of the kind has been upset by temperatures below zero during the last two days.

Copper is moderately active at regulated levels, but there is a scarcity of spot in some cases.

Tin is active and strong for future positions, but spot metal is unobtainable.

Lead is very quiet, but firm and unchanged.

Zinc is dull, but slightly firmer.

Antimony is lifeless, with a lower tendency.

The steel industry has suffered unparalleled weather and transportation conditions during the past week and through the entire month of January. This is reflected by the January pig-iron statistics of 'The Iron Age.' These show that the output fell last month to 2,411,768 tons, or to 77,799 tons per day, against 2,882,918 tons in December, or 92,997 tons per day. The month was the smallest since May 1915. Active furnaces on February 1 were 310, with 321 active on January 1, and 345 on December 1. How the industry has been suffering is shown by the fact that in May 1915, only 20 furnaces were at work to produce 73,015 tons per day, whereas last month it took an average of 315 to produce 77,799 tons per day. The steel industry of the country is operating on a 50% basis, with some plants at no more than 25% capacity. Costs have advanced so greatly that a downward revision for April will have a strong argument adverse to it.

COPPER

The principal topic of conversation is the effect of the unprecedented winter in the Eastern district of the United States. Its severity in low temperatures has never been equalled, particularly in New York, and this, together with heavy snows, has been general for two months all over the East. Below-zero weather for the third time is just passing over the East, and it is intensifying again the already bad railroad congestion. Some anxiety is felt as to the possibility of this condition affecting the supply of raw copper, in the forms of blister copper and copper matte, which comes from the West to the refineries in the East. Should this supply decidedly diminish, a scarcity would develop, temporary at least. A good stock is now on hand at the refineries but the flow of the raw supply must not be stopped for long. A scarcity of spot copper already exists in the jobbing market, one dealer reporting yesterday that he had none to sell and could get none. There is quite a general scarcity in Chicago also. At the Government prices of 23.50c., and 24.67½c., a fair business is being done, with orders booked to June 1, subject to Government needs. It is believed that there will be plenty of copper for domestic users in the long run. The production of raw copper is on a large scale, according to January reports so far published. Exports for January are estimated at about 37,000 gross tons, with imports at about 19,000 tons.

TIN

Spot tin continues to be unobtainable, and there is no prompt or even nearby market. The only nearby tin is that which is arriving, and it is applied on old contracts. Spot and Straits continue nominally at 85c. per lb., New York, with the average for January at 85.13c., nominal. The business done in the last week has all been in futures. Yesterday there was considerable inquiry from two buyers in particular, which resulted in a moderate amount of business being done. Late last week there was also some buying of futures, but the volume was not large, nor were there many sellers involved. There has been some more Government confiscation of tin. Two vessels last week brought in about 500 tons, all told, of Banca tin, which was commandeered by the Emergency Fleet Corporation. It is believed that it has been or will be restored to the original owners if they are found to be of the proper 'brand'. Deliveries of tin in January, according to the New York Metal Exchange, were 4642 tons, of which 3192 tons came East from Pacific ports. Stocks and landing on January 31 were 767 tons. The same exchange also publishes yearly statistics, according to which supplies of tin in 1917 were 120,918 gross tons, against 117,250 tons in 1916, and 121,800 tons in 1915. Deliveries were 124,423 tons in 1917, against 113,377 tons in 1916, and 118,906 tons in 1915. The visible supply for 1917 was 17,766 tons, as compared with 20,737 tons in 1916, and 16,216 tons in 1915. No arrivals for February have been reported. Spot Straits in London yesterday was quoted at £301 per ton, against £299 10s. a week ago.

LEAD

The market is firm, but very dull, and without actual interest. Quotations are about nominal at 7c., New York, or 6.85c., St. Louis, in the outside market for early delivery with the Trust price unchanged at 6.75c., New York. Demand is light and has been for some time. There has been some interest in spot lead, and a few carloads have been sold at 7.50c., New York. The supply at this end is dwindling, due to non-arrivals from the West, caused by the continued railroad congestion which has been intensified by fresh storms and low temperatures.

ZINC

Railroad congestion, storms, and cold weather are interfering with the zinc market. Conflicting orders from the Government are by no means an unimportant factor in the general confusion. It is admitted that large quantities of zinc of all grades are being consumed on Government orders, but there has been no little secrecy regarding the placing of these orders. The market as a whole continues in a dull condition; it lacks animation and snap. There is occasional buying, and the prevailing quotation is about 7.50 to 7.75c., St. Louis, or 7.75 to 8c., New York, for prime Western for early delivery, with modest premiums asked for future positions. There seems to be plenty of zinc to meet present demands, but one large producer here predicts a shortage ultimately. It is stated in various quarters that a price of 12c. per lb. has been fixed by the Government on grade A zinc. This lacks official announcement, but it is generally regarded as true. A fuel shortage is looming up as a serious factor at some Western smelters, even at those producing sulphuric acid, which the Government needs urgently. Sheet zinc is quoted at 19c., base.

ANTIMONY

The Government continues to inquire, and probably to buy, but its purchases are not made public. The market is lifeless at 14 to 14.25c. per lb., New York, duty paid, for Chinese and Japanese grades for prompt or early delivery.

ALUMINUM

Lack of demand continues, with quotations unchanged at 36 to 38c. per lb., New York, for No. 1 virgin metal, 98 to 99% pure, for prompt and early delivery.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

PIPE THAT WILL NOT BREAK

*The first of the accompanying pictures represents, not a section of rubber tubing or a piece of textile fabric, but a piece of steel pipe that has been subjected to the shock of some 40 gallons of nitro-glycerine exploded in an oil well. Only a few years ago the best steel pipe then obtainable would have been shattered to fragments by such an experience, but modern pipe is eminently 'punishable,' as the slang of the industry puts it. The case just mentioned is not unusual, we are told by a writer in 'Railway and Locomotive Engineering' (New York, October). A volume might be filled, he says, with similar ones, all going to show the great advance that has been made in the production of material of this kind. We read:

"Among the striking improvements in the manufacture of metals in recent years none is more remarkable than the advance that has been made in material for pipe. A few years ago it would have been impossible to obtain pipe that would withstand the unusual strains involved in present-day service. Some of the unusual experiences would scarcely be believed if they were not verified by a 'cloud of witnesses.' These incidents, while in a sense they may be unusual, are valuable as showing the progress made in metallurgical science, and are of interest to all who are concerned in the improvement of mechanical appliances. A volume might be made of these experiences, all showing the inherent qualities or 'punishability' of pipe, the result for the most part of unusual accidents. Indeed it would be impossible to duplicate the circumstances under which many of these unlooked-for tests occurred. In the illustrations, Fig. 1 shows a piece of $5\frac{3}{16}$-in. steel casing that was originally about 18 ft. long, and was stuck in an oil well. About 170 quarts of nitro-glycerine had been placed in the well and was suddenly shot off with the idea of blowing this piece out, and at the same time 'shooting' the well. Instead of shooting it out, however, the casing was reduced in length from 18 to approximately 6 ft. It was drawn to the surface after great difficulty and was found to be crushed, twisted, and distorted, but no fracture was shown. The incident reproduced in Fig. 2 occurred when a string of 340 ft. of 10-in. oil-well casing fell 236 ft. when an elevator let go. The picture shows what happened to the lower length of pipe when the casing hit the bottom of the well. The thread protector was forced over the threads and up over the pipe approximately 12 or 13 in., and the pipe was bent backward and inward. As will be noted, however, the material shows no fracture. This happened in the Oklahoma oil-field. Fig. 3 shows a '3 in 1' section of casing. There was a string 1440 ft. long of $8\frac{1}{4}$-in. steel casing; the elevator let go and the string of pipe, weighing something over 34,000 lb., dropped 2000 ft. to a bottom of limestone. The three sections on the bottom were telescoped, one inside and one outside. It will be seen that there was no failure in the weld, and the three lengths telescoped without a crack. The exterior apparently shows a straight length of casing. The particular piece here given was machined to show the three separate sections as telescoped. The circumstances are substantially the same as those in Fig. 2, but the results are different. This incident occurred in the Ohio field, and such experiences might be multiplied from numerous sources, as well as from files of the research department of the National Tube Company."



FIG. 2. THE END OF A HEAVY PIPE THAT FELL 236 FT. WITHOUT BREAKING.

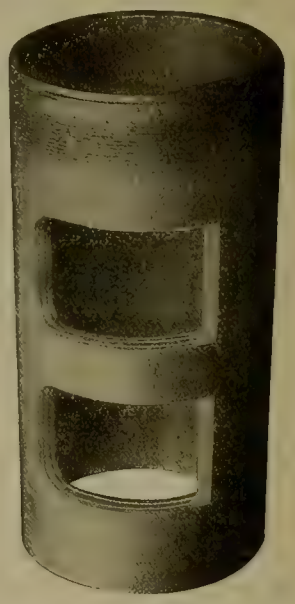


FIG. 3. THE THREE SECTIONS OF THIS CASING TELESCOPED WITHOUT CRACKING WHEN 34,000 LB. OF PIPE FELL 200 FEET.

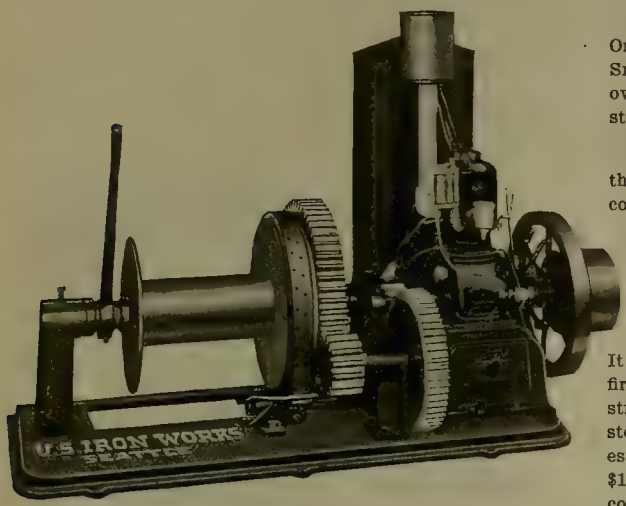
*This article was printed as an article of general interest, and not as an advertisement, in the 'Literary Digest' for November 17, 1917.



FIG. 1. A PIPE THAT CRUMPLED, BUT WOULD NOT BREAK, WHEN 40 GALLONS OF NITRO-GLYCERINE EXPLODED

DOWNIE DISTILLATE HOIST

This hoist operates on either distillate or kerosene, which can be purchased anywhere for about 10c. per gallon, and the fuel consumption is only ⅛ of a gallon per horse-power per hour. In other words, the 6-hp. hoist only consumes ¾ of a gallon per hour, which means 7½c. per hour to operate same. The 6-hp. hoist will lift 1500 lb. at the rate of 100 ft. per minute, which, under average mine-hoisting conditions, means about 1c. per ton of ore hoisted for fuel per 100 ft. of shaft, allowing for dumping and return of bucket. This, of course, is so much cheaper than a horse-whim or any other method of hoisting that there is practically no comparison. There is only one attendant required for this hoist, the same as required on any



DOWNIE DISTILLATE HOIST

hoisting apparatus; while a steam hoist requires a fireman in addition, and, as compared to cost, that of the distillate or kerosene is about one-tenth the cost of wood, and the saving is even greater when compared with an air-operated hoist. As compared with a hand-windlass, which requires two men, the saving would be so great that it would only take a few weeks to pay for a hoist of this kind. The hoist shown in the cut above is the straight line pattern and particularly adapted to mining work and is so arranged that the operator stands directly in front of the collar of the shaft when operating. There also are other patterns suitable for contractors, boat and fishery work, and general hoisting service in both the single and double drums. This hoist is simple in construction, easily operated, light, quickly taken apart for mule-back transportation, and very cheaply and quickly installed anywhere.

The design avoids the use of any gears, cams, valves, push-rods, trippers, valve-guides, springs, tappets, walking-beams, worm-gears, spiral-gears, and lever-arms, such as are included in the construction of other hoists. It does not require a mechanic to adjust it nor does it require a correspondence course or a teacher on gas engineering to understand how to run it. In simplicity of operation, and ease of control this hoist is ahead of the most complete and best-finished hoist ever built.

The ignition is jump-spark. The electric ignition is connected in such a manner that at the right moment an electrical contact is made, the electrical current passes up through the wire and down through the spark-plug, and just before the point of highest compression of the gas in the cylinder; the electric spark occurs in the very centre of this gas and air mixture. As standard equipment with each engine we furnish five Columbia No. 6 dry cells. This gives a force of 7½ volts to start with. This current then passes through a high-tension coil which transforms and intensifies it until it reaches 40,000 volts. It will not be hard, therefore, to realize why there is such perfect combustion; why every atom of gas is ignited and properly consumed in the production of power, and why there is no trouble from carbonizing in the cylinder. These machines are made by the U. S. Iron Works at Seattle, Washington.

COMMERCIAL PARAGRAPHS

E. I. du Pont de Nemours & Co. has purchased the paint and wood-finishing business of the Bridgeport Wood Finishing Co. of Still River, Conn. This will add largely to the activities of the du Pont companies in paint manufacture.

The electric transmission towers of the Niagara, Lockport & Ontario Power Co., Buffalo, N. Y., are painted with Dixon's Silica-Graphite Paint. This paint is much used the world over as a construction and maintenance paint by street and steam railroads, and electric light concerns.

E. C. Reeder, who has been the Chicago representative of the Clyde Iron Works, has severed his connection with that company to accept the managership of the Pigmy Mining Co., at Mexico, Kentucky. The Pigmy company produces fluor-spar. He will be succeeded by F. A. Putt as manager of the Chicago office of the Clyde Iron Works.

'Duplex Doings for January tells of the new plant erected by the makers of the 'Duplex' truck at Lansing, Michigan. It is in line with the latest design of factory, both as regards fire protection and healthfulness for the workers. One of the structures measures 402 ft. in length, and is 72 ft. wide, two stories high. From orders now booked the Duplex Truck Co. estimates that its output this year will reach a total value of $13,000,000. In moving from the old works at Charlotte the company gave a demonstration of what its trucks could do, the transfer being made entirely with machines of its manufacture.

The experience with a 'Caterpillar' tractor in road building in Lane county, Oregon, is one of the attractive features of 'Caterpillar Times' for January. It shows a reduction in cost over work done with teams of almost exactly two-thirds, that is, the ratio of cost of 'Caterpillar' to team service was as 1:3. Road building in connection with mining development is of growing interest, since the difference between haulage over good roads as contrasted with dragging ore-wagons over the desert sloughs during the rainy season is often the difference between economic production and idleness. Grading is now done almost entirely with tractors, and, in the case of clayey ground, the tractor is also the best machine to employ in connection with drags. In the soft low-lands of the desert, where the greatest difficulty in building roads is experienced, there is generally found a heavy growth of mesquit and palo verde, which must be cleared. Much of this is shrubbery, which can be pulled out bodily by means of a cable-hitch, and a large heavy tractor. When larger trees are encountered, the cable is hitched well up the trunk and a charge of dynamite exploded under the bottom. The dynamite breaks off some of the larger roots and loosens the balance, so that the tractor has no difficulty in pulling the tree down and dragging it out of the way, where it is cut up for posts and wood. This has been found the cheapest and most satisfactory method of clearing the right-of-way, although on some very steep hillsides, where the ground slopes rapidly across the road location, the tractor must be handled with care and skill to keep it right side up at all times. The 'Caterpillar' is less difficult to manage in such situations than other types, as it will not upset even on a slope of 30 degrees.

Mining and Scientific Press

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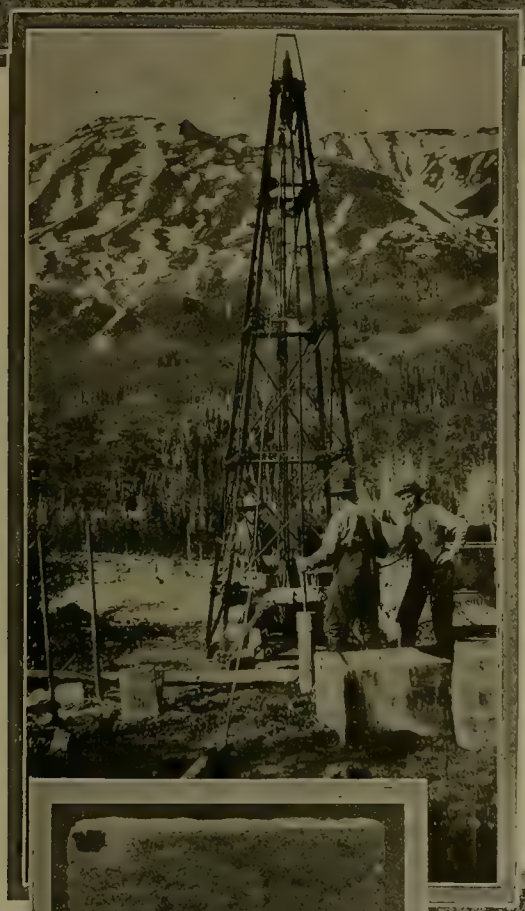
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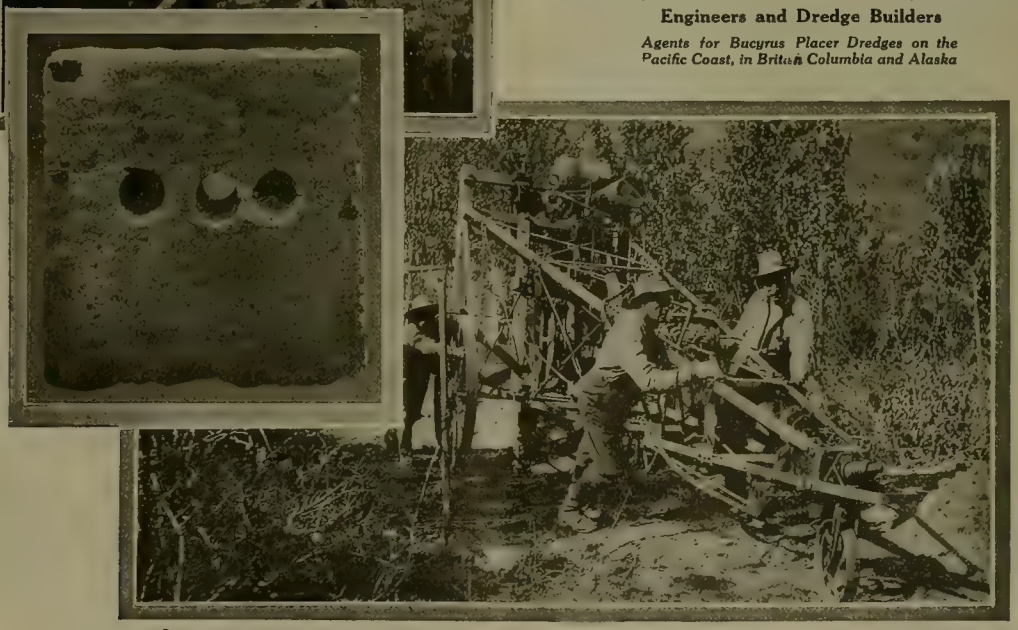
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EDITORIAL

EIGHTY THOUSAND tourists, it is reported, intend to come to California this season. If they are invalids, they do well in coming and they are welcome; if they are in good health, they had better stay at home and set aside the cost of their proposed tour as the nucleus of a fund to enable invalided soldiers to obtain the benefit of the Californian climate. At a time when the congestion on the railroads is a cause of national perplexity and during a time of crisis when all our energies and thoughts are concentrated on the big work in hand, it is wrong for people to go on pleasure-seeking tours. We class them with Mardi Gras balls, golf tournaments, and irresponsible gaieties of every kind.

CLEAR and well-reasoned discussion on the physics of flotation is a pleasure to print, and this week we present a letter from a modest technologist who has not even divulged his identity to the editorial ear, but who possesses a real understanding of the electrical conditions that exist in the complex mass of wetted pulp with its particles of mineral and gangue, its oils, and the interfacial surfaces with their active energy-relations. The suggestion of our anonymous contributor that the effect on the adhesions that cause flotation, resulting from the latent charge carried on the surface of metals, should be investigated experimentally in well equipped physical laboratories, will not pass unheeded.

CO-OPERATION is a word that is being sung on many keys, some of them minor. Mr. F. L. Ransome has been investigating the quicksilver industry of California in behalf of the U. S. Geological Survey. Shortly after the managers of mines had replied to his intelligent queries they received a letter from Mr. William Forstner, a thoroughly competent engineer, asking them to state what was their cost of operation, he being commissioned to make the inquiry in the interest of the U. S. Navy Department. We would suggest that telephonic communication be established between the Survey and the Navy offices at Washington. Meanwhile it is interesting to note that quicksilver ore containing only 0.3% of mercury is being worked profitably at the Oceanic mine, in San Luis Obispo county, because the former management had blocked out a large tonnage ready for stoping just before the market collapsed and the operation of the mine was discontinued. At the New Idria, in San Benito county, the premier quicksilver mine of California and of the Americas, a 0.45% ore is being exploited to advantage, so that, as a generalization, it may be said that ½% quicksilver is within the economic limit in California. Apparently the economic limit at Washington also can be enlarged by co-operation.

INTERFERENCE with production from American enterprises, here or abroad, hinders in some degree the success of our struggle against Germany, and is, therefore, assisting the Enemy, whether or not it be done deliberately with that intent. It is pertinent to call attention, as an instance of such injurious interference, to the fact that complaints are coming from American mining companies operating in Mexico because of the difficulty to secure permits for the importation of dynamite. Formerly it was sufficient to telegraph to the Minister of War at Mexico City; now the Minister says that he must refer the request in each case to the State government. Not only does this entail vexatious delays, but, in one instance that has been brought to our attention, the Governor of the State wired his consent, and still no action was taken by the War Department.

PREPARATION for business after the War should not be neglected. Reliance upon foreign trade to keep our factories going and our workmen employed is apt to prove disappointing. We have noted a disposition, which we think rests upon hasty reasoning, to assume that a period of reconstruction in Europe will begin the moment peace is assured, and that it will call immediately for enormous contributions of metals and manufactures from this country, sufficient to create an era of prosperity. This view is too optimistic. As soon as an armistice is arranged a period of uncertainty will supervene; no man will know whether the conference will or will not lead to an acceptable peace. Especially will this be so if overtures should be entertained before Germany has been brought to her senses, that is, before the Allies have won victory on German territory. It appears not unlikely that the Kaiser will sue for peace before such a collapse of his power. The negotiations over a general treaty of peace will consume many months,

for questions of the utmost complexity and gravity, affecting every country in the world, will be under consideration. It is evident, therefore, that after the demand for military supplies will have ceased a long period of stagnation is inevitable before normal commercial intercourse between the nations will be resumed. What can we do in the interim to avert serious financial stress? It is evident that we must turn again to our domestic problems of industrial development. These are now halted, because the materials needed are unavailable while our activities are centred upon the production of munitions of war. Nevertheless, the wise manufacturer will endeavor to keep in touch with the possibilities of business at home; he will not allow his organization for gathering information as to new projects in his own country to become crippled; he will not fail to advertise in order to keep his name prominently before the public, and he will prepare to follow the indications of business brought in answer to his advertisement so as to be ready to take advantage of them as soon as the Government's call upon his activities ceases. Above all, he must not count too heavily upon foreign business for a considerable period after the War. Europe will find an enormous quantity of raw material ready to hand in the scrap and wreckage that has accumulated during these years of struggle: this will serve as an important source of supply for her shops. We must not forget the recent announcement of M. André Tardieu, French High Commissioner to the United States, that France is able to furnish 20 divisions of our army with all the guns and ammunition that they may need for six months in addition to her own requirements for an army of over four million men now in the field. This gives an idea of the manufacturing capabilities of that country. England also has developed her equipment for manufacturing during the War tremendously. There we confront potential competition that should dispel dreams of a continuing foreign demand for our manufactures adequate to maintain our industrial operations at high pressure. We must keep our house in order to meet the strain inevitably due when the period of re-adjustment begins.

FIXATION of zinc prices, within narrow limits, has been achieved by those interested in securing fair treatment of the industry by the Government. The chief war-demand is for the higher grades; consequently the official price affects only what is known as 'grade A', which is now to cost 12 cents per pound, this price applying to Government purchases and to the open market. Grade A conforms to a minimum of 99.85% zinc, with standard limitations for other impurities as presented on our metal-market page last week. Lower grades are left to shift for themselves, and as grade A represents but a small proportion of the total zinc output the effect on the quotations for 'prime Western', will be small. Even the inclusion of sheet-zinc in the official list at 15 cents per pound will prove of comparatively little benefit for the same reason. Apparently this would indicate a price for prime Western a shade below recent quotations, and the zinc-producers will find it necessary to adjust themselves to this unfavorable condition.

The Mining of Oil

On February 14 a meeting of operators and engineers engaged in the exploitation of oil in California was called by Mr. Fletcher Hamilton, the State Mineralogist. The invitation to attend was accepted in the right spirit, so that the small room in the Mining Bureau was crowded. Mr. Hamilton explained his purpose, which was to obtain from the operators a better recognition of the function of the engineer or technical advisor. He called upon Mr. R. P. McLaughlin, at the head of the special Department of Petroleum and Gas, to inform those present what technical assistance the Bureau was giving and how the oil companies could co-operate with the Bureau in rendering that assistance of the greatest practical value. Our readers are aware that Mr. McLaughlin and his staff have made a special study of the detrimental effects of water infiltration on the flow of oil-wells and of the means to diminish this check on production. He complained that many companies failed to give the information required and that others gave it so carelessly as to stultify the inquiry; he acknowledged the cordial assistance given by sundry large companies, the officials of which were sufficiently enlightened to appreciate the aid of technology, and he asked those present to make suggestions for the furtherance of the good work. A number of geologists and engineers took part in the discussion to useful purpose, the old reactionary note being struck by only one speaker, who talked the ancient piffle about practical men being more reliable than technical graduates, raising a cheap laugh by introducing the gag about those that live down the effects of education. During the discussion the question was asked, what is an engineer; and the query was raised whether oil exploitation was mining. An engineer is a man engaged in the work of engineering, which in mining is the directing of operations designed to extract mineral from the earth at a profit. The idea of profit is implicit. Mining, and the engineering essential thereto, is not a scientific pursuit, but a business, the object of which is the making of money legitimately. The doubt whether the winning of oil be mining is a belated survival of popular ignorance. Mining is an art in which science—notably geology, mechanics, and chemistry—is used to find and beneficiate mineral deposits. The search for oil involves the use of geology even more directly, and more successfully, than the seeking for metals. The application of mechanics to drilling is obvious, and the use of chemistry in the refining of oil requires no emphasis. The idea that oil-exploitation is not 'mining' because the product is liquid is without reason, for sulphur, salt, and other minerals are extracted in liquid form, and even gold, in placer mining, is pumped. The exploitation of oil is an integral part of mining, and it is time to set aside any apologetic distinction. In any event the owners of oil-wells in Cali-

fornia know better, even if they have come but slowly to the recognition of the money-value of technical science. In this they are but human—which is to err. The pioneers of mining in this State, the gold-seekers, thought to dig for wealth without the aid of technology and succeeded in doing so during those spacious times of the Golden Age when the fruit had but to be picked. Later they found that they needed all the technical aid that was forthcoming, and more; they learned, as the oil-well driller has done, that mechanical skill must be guided by the geologist and supplemented by the chemist. We are glad, therefore, that the Mining Bureau is conducting a campaign of education beneficial to the community in general and to the oil-mining companies in particular. The State Mineralogist is to be congratulated on his prevision; we feel confident that he will receive the support of the profession, and also, we trust, of the business community.

The Pen or the Sword

During recent weeks there has been more talking than fighting. This befits civilization, but it is a pity that similar talking did not forestall the beginning of this world-war, as it might have done, instead of starting long after the great calamity was well under way. Our scholarly President appears to believe that the pen of democracy is mightier than its sword, and to this belief the peacefully minded citizen will incline to give support, provided that the other party to the controversy does not drive the point of his sword through the reasoned argument. While the President was conducting an open-air debate with Count Czernin, the Kaiser was apostrophizing his troops at Hamburg in his usual truculent manner and re-stating the Prussian resolve to compel the world to submit to "the victorious German army." The pen and the sword were being flourished against each other. It may be that the legal weapon will triumph over the lethal, and that the politicians will overthrow the militarists, but the effort is attended by the grave danger of weakening the national resolve to see this thing through. If the President succeed in detaching Austria from Germany, it would go far toward ending the conflict, as all of us devoutly wish, if it could be done without merely shortening and solidifying the Teuton lines, and without rendering assistance indirectly to Germany through Austria's restored rights as a neutral, and also through imposing hardships upon Italy that might bring discomfiture to her Government and react against her political integrity. Yet we fear the enfeebling effect of this talk from high places so long as "Germany is apparently willing and able to send millions to their death to prevent what all the world [outside Germany and her vassal countries] now sees to be just." So says the President, and he continues: "Our whole strength will be put into this war of emancipation from the threat and the attempted mastery of selfish groups of autocratic rulers—whatever the difficulties and the present partial delays." But will not the difficulties and delays obtain reinforcement from the continued parley with the outlaw and his gang? We fear the enfeeblement to follow protracted debate and the lowering of our own morale in the worthy effort to settle with the criminal—Austria—that was willing to be used as a tool for the sinister purposes of Prussia. Already we discern signs of indecision among our people; there is too easy an acquiescence with the contention that the task of curbing the outlaw is beyond the strength of England and France, even if we send increasing help to them. We do not believe it; wrong shall not triumph, frightfulness shall not prevail, if the United States, England, and France stand firm. Do the men in the trenches show a weak stomach, does this poison-gas of compromise with the enemy come from there, or does it emanate from the week-kneed that stay at home? We do dishonor to the gallant French soldiers, to the resolute British, and to our own brave boys, now beginning to take their places on the battle-front, if we imagine that any of them for a moment doubt the issue. The one virile thing today in this world of Prussianism and Bolshevikism is the young man able and willing to fight for the decencies of civilization, the sanctity of law, and the rights of humanity. We at home are either too old to fight, too young, or physically unfit, or women, or slackers; the real man is he that has shouldered arms and set forth to protect his home, to defend his country, and to preserve his self-respect. That is our view. Yet one cannot ignore the opposite opinion, as expressed by several thoughtful papers, notably the 'New Republic,' which we read for our sins and as a counter-irritant. It is held by these that a political victory is more desirable than a military decision because the one will unhorse the Hohenzollern dynasty, whereas the other will leave the German people under the control of their present leaders, unrepentant and unreconciled. They think it wiser to scheme for a political revolution at Berlin than to carry the war across the Rhine. The purpose of the Allies, they say, is to destroy military imperialism and make the world safe against such deliberate aggression as Germany prepared for forty years before 1914. With this we agree. Next they claim that to ensure the attainment of this purpose we must conduct the War so that at the end of it Germany will be under democratic control, in short, the expectation is that the War will be ended by a revolution in Germany. This also is a consummation devoutly to be wished, although declared unrealizable by that seasoned statesman, Clemenceau; in any event, shall we bring it to pass quickest by talking or by fighting? Does not the talking suggest a lack of confidence in the fighting? Are the German people more likely to be convinced by the pen or by the sword, by the mouth or by the arm? The talkative method might hope to succeed if the Germans had not proved themselves more loyal to their government than any of the peoples of the Allies to their respective governments. Are we not playing with fire when our hay-field is more dry that that of our enemy? Much as we hate the Prussian and his bestial ways, much as we may condemn

the German people for becoming the pliant tool of the dynastic ambition of the Hohenzollerns, we must recognize that the one will not throw off the yoke of the other until a military decision has proved the madness of the idea of bringing the world under the heel of the Prussian goose-step. The suggestion that we are not fighting the German people but only a group of bad men by whom they have been misguided is a mere ostrichism; we are fighting a united people, a people so ready to subordinate themselves to the idea of the State and to the direction of their over-lords that they act as if without conscience and without shame. Our talk will not undo the education of forty years of preparedness for piracy, so long as the German armies devastate Belgium, pollute the fair fields of France, and push Russia into the pit of anarchy. Let us talk with a democratic Germany, by all means, but let us stop fooling ourselves with the notion that our talking will make Germany a democracy. They, the German people, not their leaders only, appealed to the sword when the pen lay ready to their hand; they must put aside the sword before the pen can be used for something more serious than making a few timid marks on another 'scrap of paper.'

Gold, Silver, and Credits

In discussing the question of silver and bi-metallism last week, Mr. George E. Farish viewed the proposal for an issue of Federal Reserve bank-notes at an angle different from the one that led us to see in it a means for converting the debit balance of foreign treasuries, in our national account with them, so far as withdrawals of remelted silver coin are concerned, into a basis for expanding the currency. Mr. Farish considers it an anticipation of future purchases of silver to replace that exported on requisition from our Allies against the credit-allowance authorized by Congress. It would be a considerable strain upon credit to monetize our credit-balance with the Allied governments, but to issue warehouse certificates against unlaid eggs, so to speak, would be to subject the elasticity of the media of exchange to a still more dangerous tension. No doubt the average amount of silver will be produced this year and next, for the law of averages is a safe reliance; indeed, we may assume that the Produce Exchange can make a fair guess at the number of eggs to be laid between now and next Christmas, barring cholera, and Germans, and other calamities; but the less we anticipate future production of anything the safer is our basis for acquiring present necessaries at a reasonable purchasing-value of our credit medium. Credit is based after all on the supposition of the ability of the debtor to liquidate, and not to collapse in bankruptcy if called upon to settle. The credit of a government is based on the same thing, and incidentally on the belief that all men will not simultaneously demand coin. On that depends the elasticity of currency issued against a certain amount of token-metal, which still is accepted with veneration as the monetary fetish, because it is quite heavy, nearly indestructible, undoubtedly pleasing to the eye, and for the most part useless in itself. If some captious critic should force us to a re-statement of this last opinion we would submit that gold and silver possess but little intrinsic value, certainly far less than iron, or copper, or zinc; and we would then remind him that silver was more useful in the arts than gold, not alone because of its greater abundance, but because it is more easily worked, more chemically and metallurgically subservient. This is dealing with a subject regarding which we know there is no agreement among economists nor likely to be for generations to come. Therefore we may indulge ourselves in the defiant heresy of maintaining that the esteem of token-money bears an inverse relation to its intrinsic worth. We believe that the market-gauge dollar would possess transcendent merit as compared with gold, if—a huge dubitative—the world were weary of strife and difference, and were to settle down to the declining period of the career of the human race, with one government, one language, one blissful ideal of ease and inanity, sans flag, sans conscience, sans progress to any higher destiny. So, turning from the darkening sunset to the hopeful East, we still believe in gold as a fetish that man will cherish long, and on which he will base his exchange with his fellows, in a practical forward-moving world that denies the right of Germany to put us all into a universal well-ordered Teutonic filing-cabinet, or of Trotzky to bless us with the liberty of self-determination in a universal 'anarchy', or no-government, as designated under the red rag of the Bolsheviki. We still believe that silver is the weak brother, to be bought by gold, not to be given equal inheritance in the world of business. It is possible to fix the price of silver, to determine how much silver one gold dollar will buy, but if we do that we must come to definite and long-time agreements on the matter with all Europe, and with Japan and China; otherwise, as sure as the sun is in the heavens, the nations not in the agreement soon will have the gold in their vaults while we shall be stuffed with silver that can be exchanged only at a ruinous discount from its cost in gold. If, without such an agreement, we use the unmined silver as a basis for expanding credit, there will shortly be a sharp discrimination between Federal Reserve notes and the issues based on expectations of silver yet to come. Mr. Charles A. Porter, writing on this subject elsewhere in this issue, shows how readily even gold may lose its purchasing power, which disposes of the importance of intrinsic value as a factor in the monetary efficiency of any metal. It is safer, in the absence of universal treaties for stabilizing silver, to let the market demand regulate the price in the normal way, and to extend credit to our Allies for the silver taken in terms of gold, for they will pay us if our world is not shattered in its struggle with savagery, and we can even bank on that indebtedness and convert the debt into a liquid asset—which is not very different in principle from the note that a man discounts, adding his own endorsement. In that way we shall know more nearly where we stand and where we are likely to go in our effort to solve the difficulty.



Gold and Credits

The Editor:

Sir—The following excerpt from Prescott's 'Conquest of Peru' is a striking example of the economic effect of a sudden addition of a large amount of gold and silver to the money in circulation. When it is realized that a 'peso de oro' had a purchasing power of perhaps $15 in normal times of a few years ago, the picture we must form of the conditions at Cuzco becomes impressive. Prescott writes: "The effect of such a surfeit of the precious metals was instantly felt on prices. The most ordinary articles were only to be had for exorbitant sums. A quire of paper sold for ten pesos de oro (approximately $150); a bottle of wine for sixty; a sword for forty or fifty; a cloak for a hundred—sometimes more; a pair of shoes cost thirty or forty pesos de oro; and a good horse could not be had for less than twenty-five hundred; some brought a still higher price. Every article rose in value, as gold and silver, the representatives of all, declined. Gold and silver, in short, seemed to be the only things in Cuzco that were not wealth."

In this instance the medium of exchange consisted of gold and silver, and is comparable in a degree with a great increase in gold and silver in a modern community. However, there is this difference, that today our medium of exchange consists not only of gold and silver, but also of currency, checks, and the less common commercial paper. The different forms of paper money being known as 'credit money.' The increasing cost of commodities today is commonly stated to be caused by the increase in the quantity of gold. No doubt this is true, provided there is no increase in the use of checks and currency, and provided also that there is no decrease in the quantity of commodities. Also the medium as a whole must maintain its former speed and not be accelerated, for the exchange-value of a medium is dependent not only upon quantity but upon speed of circulation. The foregoing remarks should show that the increase in prices may be due to many causes, and the increase due to gold can be only in proportion to the relative quantity of the gold in circulation, that is, to the total currency in circulation. It follows, therefore, that a curtailing of the currency, checks, or commercial paper, would serve the same purpose as the restriction of gold.

The question of restricting the gold supply is not only one of stabilizing prices but also of conserving the labor used in its production. It is an open question, however, whether it is wise to seriously cripple an established industry, which in all ages has been one of the main sources of the wealth of mankind. We are all familiar with the common statement that gold is unnecessary, and that some form of credit-money, backed by responsible governments, would answer the purpose as well. But will it? Paper issued by the Russian government five years ago, and backed with all its resources, would seem to have been strong security, but what would be the value of that paper now? The German government today is solvent, but would its paper be as freely acceptable in the United States, or in many other countries, as German gold? The truth is that humanity has found, through the experience of untold ages, that gold is the surest reliance. It requires no collateral. The stamp on its face may be obliterated, the coin melted, sold as bullion, re-coined, and the stamp of another government impressed upon it; and throughout the whole process the value is there and at any time is easily convertible into other commodities. In these facts we find the real basis for the use of the precious metals for money. As far back as the dawn of history, gold has been the medium by which one man's products have been exchanged for another's. It has been found necessary, not only in higher civilizations, but in the very beginnings of primitive culture. It has formed a security beside which a United States government bond, or a Bank of England note must take second rank. The prejudice of mankind for the precious metals is no accident, it is the outgrowth of experience gained through the vicissitudes of time; it is a tending toward a security that has been otherwise unattainable, and which the present world-cataclysm can only serve to reinforce.

The rising price of commodities, as every one knows, has raised the cost of producing gold. This serves as a check upon its production, and will injure the industry even without governmental interference. Furthermore, it is a question whether gold will not in time become as scarce as it is now abundant. The War has made many changes. Suppose the exigencies of the struggle should reverse the flow of exchange, and turn the balance of trade against us. Then we will be obliged to settle these balances in gold, and we will realize that gold is the cornerstone of exchange.

It must be evident that interference with the gold-producing industry should be allowed only in the case of clear necessity and after the most careful scrutiny. It is indeed difficult, if not impossible, to foresee the ultimate effect of an interference with the natural course of industry. In a recent periodical, I read of a manu-

facturer of print-cloths, in an Eastern town, who had been grievously injured by the recent tariff law which increased the duty on imports of ivory. It appears that a large part of his goods were sent to Africa, and that payment was made in ivory. The duties made the importation of the ivory unprofitable, thus making the former direct exchange an impossibility, with the result of destroying that print manufacturer's business. This serves to show how difficult it is to foresee the effects of meddling with the delicate affairs of business.

CHAS. A. PORTER.

Kingman, Arizona, February 6.

Nickel-Copper Steel

The Editor:

Sir—I am sorry to have given the Royal Ontario Nickel Commission credit for the instigation of Alfred Stansfield's research, in my article 'Nickel-Copper Steel Direct from the Sudbury Ores,' when it really belonged to G. M. Colvocoresses. Dr. Stansfield contributed three papers to the report, namely, 'Production of Nickel-Copper Steel from Sudbury Ore,' 'Experiments in Making Nickel-Copper Steel' (which was the investigation of Mr. Colvocoresses' patent), and 'Production of Nickel and Nickel Alloys in the Electric Furnace.' Immediately under the title of the last three there is a note that reads: "This paper was prepared in response to a request from the Commission, and should be considered as an addition to Dr. Stansfield's memorandum dated 18th January, 1916. See page 38." As there was nothing stated to the contrary, I concluded that this note applied to the three papers by Dr. Stansfield, instead of to the first and last only, hence my error, for which I tender an apology to Mr. Colvocoresses. The error, however, has had the advantage at least of eliciting some exceedingly interesting facts from Mr. Colvocoresses.

F. H. MASON.

San Francisco, February 2.

The Editor:

Sir—The interesting article by F. H. Mason, in your issue of January 12, aroused lively memories, as I had pursued the same subject, years ago, but not to such a successful issue.

In the year 1890 or '91 while working on mixed sulphide ores at Leadville, using the roast-magnetizing method followed by magnetic separation, I also made tests on samples of Sudbury ores, obtained from the secretary of the company, a Mr. Macintosh of Cleveland, Ohio. I soon discovered that the magnetic separation on this Canadian ore was incomplete, that is, the nickel and copper remained in commercial quantities in both heads and tails, but the magnetic heads were much richer in nickel and lower in copper. I then roasted the non-magnetic tails and again made a magnetic separation, obtaining a high-grade iron-copper-nickel concentrate. I applied for a patent, including in the patent application the further use of one or more of the products for the manufacture of nickel-steel along the lines of the work described by Mr. Mason.

I have lost all the data, patent applications, etc., in the San Francisco conflagration, so cannot now give dates. My object in writing is the suggestion that by some such method of concentration a suitable grade of material might always be made available for doctoring a charge in any way desired, the first magnetic concentrate would be high in nickel, and the roast-magnetic concentrate high in copper and iron.

JAMES W. NEILL.

Pasadena, February 6.

Missed Holes

The Editor:

Sir—In your issue of December 1, 1917, there is an inquiry from a Mr. Harrington of Chloride, Arizona, concerning his difficulties from 'missed holes' in shaft-work.

It is not my intention to re-open the entire subject of this not unusual trouble in mining operations, but I would like to suggest a method of water-proofing the joint between the fuse and the cap that I used with marked success in shaft-sinking operations at Cripple Creek, Colorado. The method is simple, the water-proofing being ordinary beeswax. The wax is warmed until it is soft enough to work readily and is then molded around the joint between the fuse and the cap. The result is an exceptionally tight and clean joint. Beeswax is clean material to handle and has none of the messiness that goes with some water-proofing substances; also it can be used rapidly, only a short time being required to prepare a set of fuse.

From my own observations I would say that the great majority of missed holes are caused by water-proofing with the orthodox substances such as soap, grease, etc., which even when used with extreme care often allow the water to get into the cap. Beeswax has none of the disadvantages common to these materials and a trial will quickly convince one of its merit.

WILLIAM SPENCE BLACK.

Arlington, Mass., January 28.

The Editor:

Sir—In regard to the causes of misfires, which have lately been discussed, following the query of J. F. Harrington, I would state that a cause of misfires, and one that is frequently overlooked, is the careless and hurried tamping of holes, whereby a fuse is injured, sometimes by the tamping material, and again by using too large a stick, which is liable to force a portion of the fuse down with the stick, doubling it up with the tamping material. Injury to the fuse is more likely to cause a miss when the hole is wet or partly wet, or when small rocks accidentally get into the hole while tamping.

A small sharp rock jammed against the fuse is likely to cause a miss, especially if the hole is wet.

ALBERT F. STONE.

Callahan, California, February 2.

Flotation Physics

The Editor:

Sir—It seems necessary to make some further comment on the theory of electric interaction on the surface separating a conductor from a non-conductor. In a letter appearing in the discussion columns of your issue of November 10, signed by J. A. Block, certain points are brought to issue. His statements will be taken in order.

He says that native copper and silver have been found almost impossible to float, unless filmed with sulphide. May this not be owing to the ease with which these metals are tarnished? O. C. Ralston* states that freshly precipitated copper is easily floated although in a minute state of subdivision.

The adhesion between grease and diamonds and the slight preference of sulphur for oil might still be due to exceptional exhibitions of molecular surface-tension. There is every reason to believe that such surface-tensions have their effect in flotation, though in a minor way. The surface-energy calculations of Clerk Maxwell give a firm theoretical basis for such a belief.

The statement that the latent charge on the surface of the conductor is exactly the same and opposite in sign to the residual charge in the interior of the conductor may be correct, presuming that the outside of the particle is grounded. To be strictly correct, however, we should probably say that the combined charges in and on the particle and the grounded electrolyte immediately surrounding it may be summed to zero. Such an understanding disposes of the apparent repudiation of an electro-static theory made by F. A. Fahrenwald,† because his experiments only pricked the bubble that buoyed up our hopes of differential flotation by electrostatic means. These experiments did nothing to affirm or deny the possible flotative effects of the electric differentiations, which we know perfectly well to be existent at and near interfacial surfaces. Electrolytes themselves act like diluted metals and evolve a voltage difference at and near air and solution interfaces. This voltage difference is small compared with that of metal surfaces, but it may have its modifying effect on flotation.

The statement is made that the ordinary laws of electro-statics do not apply at molecular distances. While we have to be satisfied with only the most vague idea of the internal composition of an atom, and it may not be that the ordinary laws of electro-statics apply there, we are much better informed about the phenomena external to the atoms and to which the electrostatic laws do apply. The whole ionic theory as developed by Arrhenius has to do with electro-static charges and their attractions and repulsions, and the science of electrolysis may be said to be founded upon that theory. Owing to the great size of the unit-electron charge, the actions are not of necessity confined to "molecular distances." Such is the amount of energy stored in the atom that we may be sure that there we have to do with a different order of magnitudes. The hydrogen atom, for example, may contain a thousand electrons strained into its small capacity, but a single free unneutralized electron, among a billion hydrogen atoms, would constitute a considerable density of electricity.

Was it not Sir Humphrey Davy who first tried to show an exact connection between the surface-tension and the intrinsic cohesive stress existing in a liquid? As the former is measured per unit-length and the latter per unit-area the two measurements cannot be connected unless factors involving the size of the molecules are also taken into consideration. In the same way we might, with some assurance, presume that there would be no electric surface-tension, as we have called it, if electricity were an infinitely divisible fluid. We cannot say exactly how the electric surface effect is brought about, but there is hardly any way in which we can imagine electrons in motion in a conducting body, without there being a modification of that motion at the surface of the conductor, and therefore a change in the 'condensation' of the electricity, that is to say, a change in the number of free unneutralized electrons within a given space. The cause of the motion may be the internal heat in the body, which heat is also related to the molecular and atomic motions.

The latent charge of the surface of metals is already known to affect chemical affinity, through the medium of electrolytic and allied actions, and it remains to be seen how far flotation adhesions may be also so affected. This would seem to suggest a promising field for an intelligently conducted line of experiments, and if the relation suggested were thereby established, it would not only settle this question but would form the thin edge of a wedge which would go a long way toward the establishment of flotation as a science.

X.

Washington, December 5.

[The writer of this letter failed to attach his name to it, therefore we regret to have to give it anonymous publication.—EDITOR.]

*'Flotation,' Rickard and Ralston, p. 104 (1917).

†M. & S. P., March 11, 1916.

In Camp

The Editor:

Sir—Arrived here on schedule time Monday morning, the 7th, about 10 a.m., and by noon I had been assigned to quarters and established my belongings. At 1 p.m. I fell-in with the rest of the recruits and was marched out to the drilling-grounds where I spent the rest of the afternoon doing squads right and squads left, so you see when they once get you here it does not take them long to get you busy.

THE DAY. Get up at 6:15, answer reveille at 6:30 a.m., which is followed by breakfast. 7:30 a.m. we fall-in and are marched to the drilling-grounds, where we are instructed in drilling and are put through setting up exercises and back to our barracks by 11 a.m. From 11 to 12 a.m. clean-up for dinner. Dinner from 12 to 1:30 p.m. At 1:30 p.m. we fall-in again and are marched to the drilling-ground, where we get more drilling and finish up with a hike of from 4 to 6 miles. We are back to the barracks by 4 p.m. From 4 until 5:30 p.m. clean-up for supper. At 5:30 p.m. we stand retreat. At 6. p.m. we march to supper. After supper we are allowed to go any place we want to within the lines (providing your regiment is not quarantined, which is our case now. The 27th has been quarantined since the first part of December, but they expect to lift the quarantine in about 10 days) until 9:45 p.m. and at 10 p.m. we are supposed to be in bed so as to be in shape for the morrow.

THE BARRACKS in which we are living are two-story wooden buildings about 80 ft. long, 35 ft. wide, and 10-ft. ceilings. There are about 35 half-size iron beds on each floor, on which we have a straw mattress and four Army blankets. The first night I spent most of the time trying to keep myself covered up, but it doesn't take long before you learn to lie quiet. There are plenty of windows, but the nights have been pretty cold, so the men would rather have them shut; however, we have had ours open above our beds and have managed to keep from freezing up. In the centre of each floor is a large stove that burns hard coal when we have it, otherwise green wood. This camp-site was covered with small trees, so there is plenty of wood.

MESS-HALL.. One-story wooden building about 125 ft. long, 25 ft. wide, and 10-ft. ceiling. Each mess-hall is supposed to accommodate one company, or 250. They have done away with individual mess-kits during this cold weather, and instead everything is placed on the tables in very much the same manner as a mine boarding-house is run. At present we have about 400 men in this regiment, and only one mess-hall, so that it makes things bad. After the first bunch of men have been fed, 150 plates, cups, knives, forks, and spoons have to be washed before the second bunch can come in to eat. That is not the worst feature, however, as the stove they have is only large enough to take care of 250 men, so, in order to take care of 400, all side-dishes have to be cut out. The men are complaining of the food they are handing out, and they often have good cause, because the food runs out before the second table gets all they want. This, however, will be remedied when we move to new quarters, which will probably be this week. As long as one has money he need not go hungry, as one can buy most anything you want at the exchanges. Exchanges are small stores run by different regiments and the proceeds of which go to the mess-hall for extra good things to eat. The 27th so far has no exchange.

THE MEN. As one would expect, we sure have a Duke's Mixture here. In one bed lies a tough Butte miner and probably in the next a Gen. Mgr. The last three days have brought in a mighty fine bunch of men. They all look like men of means and ability. The quarantine was too much for some of the miners, so New Year's day eleven got through the lines and went to Baltimore for a big time, and I guess they had it. They didn't come back for a week, and, of course, when they did they were court-martialed and sentenced to four months at hard labor with half-pay. So now we do not have to chop our own wood any more. One would think that a sentence like that would make a man feel just a little blue, but not for those boys, they are the happiest lot in camp.

K. P. means Kitchen Police, it means waiter and dish-washer. Each day 7 men are assigned to K. P. duty. Last Friday was my first. You go on duty at 6:30 a.m. and if you work good and fast you can get through by 7:30 p.m. The 7 men are divided as follows: Four are assigned to wait on tables and wash all dishes, two are assigned to the kitchen to wash all pots and kettles, and the seventh is assigned to chop wood for the kitchen-stove. That was my job, but on account of the prisoners chopping all the wood, I scrubbed out the refrigerator from stem to stern and helped to cut up the beef. This is the kind of duty that makes the boys wonder why they left home. This is the remark that I hear 50 times a day: "If I ever get out of this, they will never get me again"; however, some of the boys who made this remark a few days ago are gradually changing their mind, as they see that all these things are necessary for success.

I was very much surprised to arrive here and only find 350 men in the Regiment, but I understand that Major Perry is in Arizona now getting recruits.

Am feeling fine and in the best of health.

Remember we are always glad to gets news from Home.

ED.

Camp Meade, January 13.

MOLDED BLOCKS of gypsum plaster can be used in arid climates for exterior construction. They are so used in Bighorn Basin, Wyoming, and at Douglas, Arizona. The blocks are made of uniform size, hollow, and with smooth sides except the face to be exposed, which may be smooth or molded to represent rough-dressed stone. Warehouses, garages, and other simple structures in Douglas, Arizona, are built of hollow gypsum blocks 8 by 12 by 24 inches. Such gypsum-block structures are estimated to cost one-quarter less than brick buildings of the same design. On account of the size of the blocks the walls can be laid faster, and less skilful labor can be used.

GYPSUM PLASTER is used at some copper smelters as a binder for concentrate and flue-dust. It is mixed with the flue-dust and sacked. The plaster sets, making the contents of the sack a solid block, which is sent to the furnace for recovering the metals originally carried away in the flue-dust.

The Apache Trail, Arizona

By T. A. RICKARD

The road between Globe and Phoenix, in Arizona, is called the Apache trail because it follows the track used by the original inhabitants and possessors of this region.

On a sunny morning last May I had the pleasure of traveling with Messrs. J. Parke Channing, B. Britton Gottsberger, and D. G. Scott, from Miami, past the outskirts of Globe, to Phoenix. It seems worth while to record the experience for the sake of those that know the road and to whom therefore my notes will serve as a fillip to their own memories, and for the sake of those to whom this celebrated road is unknown, to whom therefore may come the pleasure of an awakened imagination.

It was early in the morning when we started; the air had the freshness not only of dawn, but of dawn in an arid and spacious country in which the air is uncontaminated by human industry. I was reminded of a similar morning 23 years earlier at Tucson, when I had to take the overland train at 4 a.m. and felt the stimulus of that same invigorating atmosphere. The memory of it was fixed by an incident on the train soon after I had gone aboard. Only one section was vacant in the pullman, so I made use of it. A few minutes later a distinguished looking old man (he seemed 'old' because he was about 25 years my senior) emerged from the berth across the aisle and asked if he might place his bag on the vacant seat opposite mine. Looking at the bag I saw the name 'T. Sterry Hunt' inscribed on the leather. I knew that Thomas Sterry Hunt was dead, so I remarked that I had recently read a book of chemical essays by a man having the same name. Whereupon my fellow-traveler said: "He used to be my partner." "Then," said I, "you must be Professor Douglas." "Yes, I am Mr. Douglas," he replied. When, in return, I gave my name, he asked me which Rickard I was, and, on being told, he referred in a kindly way to my father, whom he had known many years previously. That was my first meeting with James Douglas, on whom no prefix of Doctor or Professor can bestow any increase of honor.

As the motor-car bowled along the broad concrete pavement connecting Miami with Globe I thought of my honored friend and hoped that he might be spared for many more years of usefulness—for I knew that he had been ill recently. The bracing sunlit air, not yet hot, and still free from dust, recalled another scene in a region far distant. When Scott Turner and I arrived at Dawson, in the course of our journey down the Yukon, ten years ago, we reached the Regina hotel at 6 o'clock in the evening. It was July; in that northern latitude there was no sign of sunset even so late in the afternoon. Soon we were sitting at a table by the open window enjoying a meal that was all the more appetizing by contrast with our experience on the river-steamer from



MAP SHOWING THE APACHE TRAIL, FROM GLOBE TO PHOENIX

White Horse. Again came that delicious feeling of dawn. The air was fresh without being cold, it was as pure as at the creation, for it came across the Arctic snowfields. There was nothing worn or second-hand about it. It made one feel as if "the world was young and life an epic." The memory of it is vivid to this day, and is heightened by recalling the fact that my friend Turner is one of those that survived the sinking of the 'Lusitania.'

The motor-car sped over the Miami flats, passing close to the cultivated tract on which the Miami Copper Co. is trying, not unsuccessfully, to grow those food-products that are at least as necessary as metals for the conduct of the War. We passed the pumping-plant, where the old Dominion mine-water is brought by four miles of 14-in. wooden pipe to a reservoir made by an earthen dam, to be pumped thence to the Miami mine, at the rate of 2,000,000 gal. per day, through another four miles of 14-in. pipe, the lower part steel and the upper part cast-iron, against a pressure of 620 ft. As a reserve, two wells are equipped with submerged centrifugal pumps, each driven by a 100-hp. motor able to pump 1500 gal. per minute. The first time this reserve water was used the pipe-line was ruptured by the breaking of lugs at the joints, owing to the sudden contraction caused by a 20° difference of temperature. Now the well-water is diverted to the reservoir or it is raised by one side of one pump so as to reduce the temperature slowly. The breaks made in the pipe-line were due, in part, to the fact that the upper portion was made of cast-iron. Obviously cast-iron is not to be recommended for such a purpose. I might describe the electrical equipment—for the pumps are driven by electricity—but technical details are out of place in this article, which is intended to be as easy as a joy-ride across the desert.

Turning northward from Globe the road passes by a field of barley, the tender green of the young grain contrasting gratefully with the desolate mountains in the background. A covey of quail crosses the road. Animal life is not wanting. Gophers, rabbits, lizards, and ground-squirrels are seen at intervals. We reach the divide between Pinto creek and Pinal creek at an altitude of 3980 ft. Ahead are the Four Peaks, which remain in sight all the way to Phoenix. A few yards beyond the divide we catch a glimpse of the horse-shoe lake made by the Roosevelt dam. Descending the slope we traverse a natural garden. The desert is in bloom. The palo verde with yellow blossoms, the flaming flower of the ocotillo, the tall column of the sahuaro surmounted by a white cluster, the red and yellow of the prickly pear, and the purple of an opuntia cactus furnish a feast of color, but no fragrance—that belongs to moister air. To the north is the Sierra Ancha, showing a pine forest silhouetted on its crest. From there came the timber for the big dam. Along the divide granite appears, with patches of diabase. The excellence of the road is related to the petrography, for the granite by disintegration and by the cementing action of rain on the kaolinized feldspar makes a splendid traction surface. Lower on the Pinto water-shed the road cuts through Gila conglomerate, reminding one of the Miami geology. Against the sky stands one of the towers of galvanized lattice-steel that carry the wire by which electricity (under a pressure of 44,000 volts) is transmitted from the Roosevelt dam to the Inspiration and Miami copper mines. The power-line is of the suspension type of construction. Six lines are carried: two lines of three wires each, two ground wires, and two telephone lines. A lark lifts his voice in song. He utters the same triumphant note here in the desert as over the Sussex meadows. The vast perspective of the Arizonan landscape disappears as in a cinema and I see the sandy foreshore of Deal; underfoot I feel the turf of a perfect golf-course, in the offing are fishing-boats, ahead is a little flag set in a circle of velvet green, the voice of a friend comes to me, and overhead the same meadow-lark carols the song he has carried across the world.

As we descend the hill the accelerating car draws the road under it like a ribbon gathered on a reel. A buzzard lifts himself on heavy wing; an oriole flits through the brush. We can see the edge of the lake made by the dam and one or two ranches beside the rivulets that feed it. Crossing Pinto creek we find a camp of the State Highway Commission, which is engaged in building a concrete multiple-arch bridge across the dry bed of the stream. Our New York engineer expresses the opinion that such a bridge is quite unsuitable, because a rush of water comes down the creek twice yearly, and the foundations of the bridge should be deep in order to be secure; a pile-bridge might serve better.

Emerging from the creek-bottom we discern cliff-dwellings in the face of a rocky hillside to the left. By aid of a field-glass the details can be observed. These ancient habitations are placed in a cave under an overhanging cliff of rhyolite—not that we can determine the petrography at this distance! The overhanging cliff protected the dwellings from rain and made them easily defensible against an enemy; they are built of flat stones plastered with mud, the ceilings being made of clay reinforced by small sticks.

These cliff-dwellings were among the marvels that caught the eye of the *conquistador* when he broke into this part of the North American continent. The first white man to penetrate what is now Arizona was Alvar Nuñez Cabeza de Vaca, the leader of a party of five Spaniards abandoned in Florida by the expedition of Pamfilo dè Narváez in 1538. Nuñez, marooned in the swamps of Florida, decided to find his way to Mexico overland and led his little party westward across the Mississippi and the Arkansas into what is now New Mexico, eventually reaching central Arizona, whence, after many perilous adventures, he rejoined his compatriots at Culiacan, in Mexico. Nuñez and his companions told highly colored stories about the Seven Cities of Cibola, meaning the Zuñi villages, and thereby aroused



OCOTILLO AND OPUNTIA CACTUS. THE FOUR PEAKS IN THE BACKGROUND



APACHE INDIAN WICKIUP BESIDE THE ROOSEVELT LAKE

the cupidity of the Spaniards and the religious zeal of their padres. Early in 1539 one of the latter, Marco de Niza, led a small expedition from Culiacan to the supposed Seven Cities. This missionary traversed Arizona and set up the emblem of Christianity, calling the country the New Kingdom of San Francisco, a name that still clings to the range of mountains separating the Verde from the Colorado river. The padre returned safely to Culiacan and capped the story of Nuñez with his own yarns about a marvelous country to the north. In April 1540 Vasquez de Coronado led a bigger expedition, mostly Mexican Indians, into the Pimería, as the region was beginning to be called. Coronado passed northward along the valleys of the San Pedro, the Salado, and the Verde, reaching the Zuñi villages in 45 days after his start from Culiacan. He found that the rich and populous cities described by his predecessors were only insignificant groups of stone and mud dwellings tenanted by quiet and industrious Indians possessing no treasure of gold and ignorant of mining. Both Nuñez and Coronado saw the wonderful ruins of Casa Grande and many other cliff-dwellings in the course of their explorations. The first mineral wealth disclosed in Arizona was the silver ore found in 1582 by Antonio de Espejo at the head of the Verde river in the district now known as the Black Hills.* In 1847 all of Arizona north of the Gila river was ceded to the United States by the treaty of Guadalupe Hidalgo and in 1854 the southern portion was acquired from Mexico under the Gadsden purchase. The name 'Arizona' is of dubious origin. By some it is said to be derived from Arizuma, a name said to have been used by the early Spaniards. The most likely derivation is the Spanish-Indian 'arizonac', meaning 'few springs.' This was the name of an 18th century mining settlement in the Santa Cruz valley just south of the present border of the State.

Near Tempe are mounds containing the ruins of ancient dwellings that must have been as imposing as those of Casa Grande. Lines of a canal can be traced from the ruins to the bank of the Salt river, suggesting how water was brought to this pre-historic pueblo. Indeed the wide valley of the Salt river and the spacious plain separating it from the Gila valley contains so many remains of dwellings and canals as to indicate that this region was once thickly inhabited by an industrious and intelligent people.

The origin of these habitations was imputed formerly to an extinct race, but it is now believed that the cliff-dwellers in the region covered by parts of Colorado, New Mexico, and Arizona were the immediate ancestors of the Pueblo Indians. They were so named by the Spaniards because they lived in villages, instead of roaming wild; they were the semi-civilized, sedentary, and agricultural tribes, now best represented by the Hopi and the Tegua, whose villages still crown the tops of many mesas. These gentler folk made their homes under the beetling cliff in order to protect themselves against the wilder Navajo and Apache tribes. In French the word Apache has become the synonym of deviltry and it is a fact that this tribe was the last to submit to the white man's domination. At the close of the 18th century in England the word Mohawk, the name of an Indian tribe then inhabiting the State of New York, was employed as a synonym for bands of lawless or rowdy persons.

At the beginning of the Civil War the withdrawal of Federal troops gave the Apaches a chance to break loose and they made the most of it, marauding the country so that all mining enterprise was stopped. From 1863 to 1874 the history of Arizona is an ensanguined record of the stubborn fighting between the incoming settlers and the belligerent Indians. In 1874 General George Crook subdued the Apaches and placed them on reservations. The Apaches were conquered, after much fighting, by General Nelson A. Miles in 1886, their last stand being made in the Chiricahua range, where they surrendered, to be deported to Florida and Alabama. About 5000 Apaches now occupy reservations in Arizona. This race comes from the frozen North; it is of Athabascan stock; on migrating to the warm southland the Apache developed the fighting habit. Among the most belligerent were the Tonto Apaches, who live along the stream of that name feeding the Roosevelt dam. It is worthy of note, however, that the Apaches practised irrigation before the white man invaded their domain. They impounded the stream and built canals plastered with clay. As we shall see, the Indian and the beaver alike had notions of dam-construction long before the Reclamation Service came to the aid of the settlers in the Salt River valley.

The road now approaches the lake, which it follows. It is good to see such a body of water in a dry region. One of our party enquires after trout, whereupon another recalls the story that George W. Maynard used to tell of a Washington official that wrote to the Secretary of the then Territory of Arizona enclosing a blank for fish statistics. The Secretary scribbled across the blank: "Last known fish in Arizona was seen twenty years ago going up Hassayampa creek with a canteen under his fin looking for water." That, of course, is a libel. Nowadays people come from afar to fish in the Roosevelt lake, where black bass weighing six and seven pounds are caught; also carp.

As we turn a sharp corner the outlet of the lake and the dam itself come into view. Alongside the road, between it and the water, one sees the concrete channel or ditch that supplied water for the power used during construction. Above the road a group of pretty houses and a rose-hedge in bloom mark the quarters of the local representatives of the Reclamation Service. On the hillside to the left of the dam the cement plant employed during the construction period looks like a cliff-dwelling when first seen. Across the dam another group of buildings marks the former site of the contractor's camp. The Southern Pacific Company has a hotel at the water's edge. Tents along the shore of the lake suggest camping parties, attracted hither from the mining settlements.

*'The Resources of Arizona,' by Patrick Hamilton, 1883.



TONTO CLIFF-DWELLINGS



THE BRIDGE AND THE LAKE ABOVE THE DAM

The distance from Globe is 40 miles, and from Miami 44 miles. From the dam to Phoenix is 78 miles.

The Roosevelt dam was designed to reclaim 240,000 acres of arid land. The first stone was laid on September 20, 1906, and the dedication by Mr. Theodore Roosevelt took place on March 18, 1911. The site was in the heart of a wilderness, 62 miles from the nearest railway, at a place where the Salt river had eroded a narrow gorge that could be blocked advantageously. The first thing done was to build a good wagon-road, at a cost of $300,000. Then power had to be provided for the contractors. This was accomplished by building a small concrete dam across the Salt river at a point 19 miles up-stream. There the water was diverted and conducted along a cement-lined ditch to a point just above the dam-site, where it dropped 220 ft. on turbines that generated 4000 horse-power. Next a mill had to be built for the making of cement at the rate of 500 barrels per day. This mill supplied 340,000 bbl. of cement at a saving of $600,000 over the lowest bid offered outside. Owing to labor shortage, due to the heat and the remoteness of the locality, the engineer in charge availed himself of the Indians, who proved excellent workers and acquired habits of industry that have fitted them for employment on railroads and other later enterprises in Arizona. The rock for the structure came from the sandstone of the canyon. The dam is 280 ft. high; the base is 168 ft. thick; it is surmounted by a roadway 16 ft. wide and 1080 ft. long, arched up-stream. In plan the dam forms a quarter-circle, with waste-weirs 200 ft. long at each end and spillways cut in the solid rock. The dam has three openings to regulate the outflow. In the canyon below is a power-plant of six turbines operating a 1000-kw. G. E. 2300-volt 25-cycle generator. Electric light and power are supplied to Phoenix, Globe, and other towns; also to the mines. The reservoir has a storage capacity of 1,284,000 acre-feet.

Below the dam the road climbs along the side of a rugged gorge. Patches of purple granite appear in fine contrast with the sunlit green water. An occasional cottonwood tree lying prone on the bank marks the work of the beavers, who cut them down, by aid of their powerful incisor teeth, to make their dams. One does not know which to admire most, the big concrete structure built by man to impound the aberrant waters or the logs cut down by the beavers, dragged by them to their dam-site, and laid in place with instinctive intelligence. The little rodents carry mud and stones in their fore-paws and drag the timber with their teeth. They work at night and that is why they are rarely observed. Where the water is quiet they make the dam straight across, but where a current runs they curve the structure so that its convexity is up-stream. They are sociable and co-operative little animals; in this respect, as in their intelligence, they set an example to man, of which he has availed himself. The cutting of trees by the beavers in the gorge just below the Roosevelt dam looks like a blunder on the part of the little brown engineers—a misdirected instinct—for the current is too strong and the volume of water too great to permit them to build a dam. They are migrating down the Salt river; perhaps they intend to float the logs to a lower reach of the stream for use there!

Looking back at the great wall of the dam, Mr. Gottsberger remarks that it is unusual for the water to be coming over the spillway so late in the year and he explains that this indicates a slow melting of the snows in the mountains and that the Salt River valley is assured of sufficient water for three years.

The road leaves Salt river and turns along Fish creek into an imposing rocky gorge that shows no outlet until a sharp bend has been turned. Our car, an 8-cylinder Cadillac, took the Fish creek grade on second. But that was less wonderful than the rocky battlements and stone terraces that framed the gorge where far below the blue of the river threaded its insistent way. How long did it take to cut that valley? Nay, how much longer did it require to accumulate the sediments and to pour the lavas that make the substance of these mountains? The geologist tells us that the patient forces of erosion—the expansion and contraction due to the difference of temperature from day to night—the cracking by frost, the blistering by the noonday sun, the washing by snow and rain, the grinding by the blown sand—these persistent atmospheric agents sufficed to carve the ravines and sculpture the mountains. The average man accepts the explanation as a fine piece of scientific reasoning, but it leaves him more admiring than convinced. The failure to appreciate the explanation is due in the first place to the fact that nature usually works unseen; the falling stone and the riven rock are rarely watched because the work is done at dawn and in the twilight when the changes of temperature are most marked. When the storm is at its height, man goes indoors for shelter and lets nature do her worst unobserved. Near the Apache trail, at Mormon flat, the traveler can see a white scar on the face of a cliff where a bastion of rock was blasted eleven years ago by a thunderbolt. The engineers in our party guessed at the weight of the fragments lying on the talus at the foot of the cliff; between 6000 and 10,000 tons. Such an act of destruction is rare as measured by the observation possible within the span of human life. Time is of the essence in geology. Nature has been given a blank check on the bank of Time; to man, as to a vagrant ant, the periods of geologic operation seem immeasurable. We take a thousand years as a unit and therewith measure the time since the first trace of man appeared on the earth's surface, but that was the last minute of a day that began in the dawn of a remoteness beyond our reach. At the theatre they drop the curtain between two scenes "to mark the passage of time," a day or a year, as the text of the play may require. Our geologic periods are like those brief intervals on the stage; they are merely suggestions of the æons that have passed like the shadow of a cloud upon the snow.

The road up the Fish creek divide might well intimi-



THE PAINTED CLIFFS, FROM THE APACHE TRAIL



THE ROOSEVELT DAM

date an inexperienced driver. The story is told of a man that was driving a light touring-car and found that his brake did not work properly because he had no weight over his back wheels, which skidded repeatedly, until he was in a state of nervous collapse. He stopped the car and walked to the nearest road-house. The man sent to fetch the car had to throw stones in the rear of the chassis in order to correct the effect of the grade. Mr. Scott told us how he overcame this trouble by taking two or three gunnysacks and loading them with sand to serve as a counter-balance.

Fish creek is one of those contrary names so common in the West, what the academic term *'lucus a non lucendo,'* a grove being given a name derived from the Latin word for light, although a grove is a dark place. From the fishless creek the road crosses Tortilla flat and much of it is on bare rock requiring careful driving. The traffic is light. Long teams with jerk-line drivers are a thing of the past. We passed motor-cars in groups of three, these being the modern equivalents of the old leather-thoroughbrace stage-coaches. One of the motor-stages had a trunk tied outside so as to endanger a passing vehicle. This is against the State law, by which no public vehicle may carry anything that projects beyond the footboard. We met a wagon and a trailer loaded with boards for the building of a house. The front end of the trailer's load was bumping into the lumber on the leading wagon so as to smash the ends of the boards and necessitate a fresh sawing to make them fit. It is better to be sure than sorry. In the course of the journey as far as Tempe, where local traffic begins, we met six wagons and 18 motor-cars.

Emerging into more open country the Superstition mountains are silhouetted against the western sky—a grand mass of rock surmounted by pinnacles like tombstones. The name 'Goldfield' inscribed on a post marks the scene of mining, indicated further by a couple of dumps. It is not clear whether this is the kind of mine from which gold is won or whether it be the kind into which gold is diverted. Both kinds seem to be needed in order to promote human knowledge. The road improves as it enters the expanding valley of the Salt river. One is reminded of the wastefulness of poor roads, particularly in these days of motor traffic, when the vehicles most used represent so large an investment of capital. To a European our road-making seems short-sighted and shiftless, for it is so hastily and cheaply done that it requires continual repairs or, as is more commonly the case, a relapse into permanent disrepair. Against such criticism it may be urged that our mining communities are so ephemeral that it is inadvisable to spend much money in the construction of durable highways. This is not a satisfactory excuse, because most mining centres remain active much longer than the wretched roads built to serve them, and a good road once built contributes not only to the prosperity of the particular district that it taps, but it also affords invaluable assistance in the exploration of the adjacent country. The railroad diminishes the scope of the wagon-road, but now that motor traction is gaining rapidly in favor and usefulness it is worth while to lay stress on the need for better road-building in our mineral regions. As these ideas come to mind we are speeding smoothly over an excellent surface of granitic débris. A bird flits into a cholla, a peculiarly prickly cactus. Dismounting two of us examine the nest, so thoroughly protected from snakes and owls by the natural spears that surround it.

At the 95-mile post, as measured from Globe, we enter an area of irrigated cultivation. The altitude is 1000 ft. A finger-post points the turning to Superior 35 miles distant, where is the celebrated Magma copper mine, not only a source of copper but the scene of technical research of a high order of usefulness. Soon we are traversing smiling farm-lands. I hear somebody remark that 12 cuttings of alfalfa are obtained in a year! The lyre-bird is not extinct. We approach Tempe, named after that vale under Mt. Olympus in Thessaly whose beauty of landscape and mildness of climate are proverbial. This Arizonan scene is grateful to the eye of those emerging from the barren lands in which copper and gold are mined. The road crosses broad ditches in one of which children are bathing merrily. A school-house among the cottonwoods bespeaks the herald of civilization and the making of good citizenship. Dairies and manufactories of condensed milk indicate the prevailing industry. The road is now crossing a succession of Mormon settlements, thrifty and prosperous.

The population of the Salt River valley includes 4000 Mormons. A few of them are also to be found among the Indians. The chief Mormon settlement is Mesa, through which we passed before reaching Tempe. Mesa was one of the early white settlements in Arizona; it was founded by the Mormons, who have built a number of substantial meeting-houses and community stores. Farms and herds of cattle bespeak the prevailing occupations. They make good citizens, being industrious and sober, keeping to their own affairs as much as possible. Although they have a vote, and take part in politics, they do so chiefly to protect the welfare of their own community. They are good men of business and capable of driving a shrewd bargain; quick and frugal, earnest and faithful to their creed. Mesa is 16 miles east of Phoenix; 10 miles beyond is Lehi, where the Mormon Indians dwell with white settlers in a small agricultural community.

At the 116-mile post, after 9 hours of travel, we enter the environs of Phoenix, and pass four or five miles of villas and bungalows built for the use of wealthy tuberculous invalids from all over the United States. The desert air is softened by irrigation, the climate is genial, if a little hot during mid-summer. I am reminded of Clarence King and Joseph A. Holmes, both of whom came here to fight for life. Holmes had been appointed the first director of the U. S. Bureau of Mines and had established the Bureau as a tower of administrative usefulness in the best interests of the mining industry when he died here in 1915; his hand was firmly

placed on the plough and he was making deep straight furrows across the field of industrial progress when he was summoned to leave the work on which he had set his heart with convincing earnestness. When he retired to Phoenix he still retained his post, hoping to return to it, while the active work was performed by his loyal comrade, Van H. Manning, now his successor. Since Holmes has died sundry well-meaning persons, including several that had done all they could to prevent his appointment to the head of the Bureau, have endeavored to memorialize him by means of medals and by founding chairs of safety engineering, but his monument endures in the work that he did and the organization that he created, both of which promise to preserve his name in unfading honor. The other courageous spirit, Clarence King, was one never to be forgotten by those that knew him. I have referred to the Apaches; it is worthy of note that King was nearly their victim. Dr. Raymond tells how King and Gardiner were engaged in a geological reconnaissance when one day, on the road to Prescott, they had ridden ahead of their cavalry escort. Absorbed in conversation they were surprised by a couple of Apaches, who sprang from the bushes and with arrows aimed at their breasts called upon them to dismount. Gardiner's impulse was to use his revolver, but King restrained him, guessing that these two Indians were members of a larger party. In a moment fifty Apaches emerged from the chapparal and surrounded the two white men. They were compelled to dismount and remove their clothes, in preparation for torture. King realized that the only chance of escape from death was to kill time so that the escort might come to the rescue. So he showed them his cistern-barometer and explained, in Spanish and by signs, that it was a new kind of gun of very long range. Meanwhile the Apaches prepared thongs for their captives and lighted a fire to place on their breasts. They were half-stripped when the cavalry arrived and, realizing the situation, charged immediately, scattering the Indians and saving King and Gardiner unhurt. King was a vivid personality, a chromatic character, a beautiful spirit. At the end of an active, useful, and inspiring life he came to Phoenix, late in 1901, having been attacked by pneumonia after the germs of tuberculosis had fastened themselves upon him during a trip to the Klondike in the preceding summer. He died at Phoenix on Christmas eve, 1901. A keen student and observer, a born teller of stories, buoyant and versatile, sympathetic and intellectual, it is remarkable how little he left in writing, but how deeply he wrote himself on the hearts of his comrades, many of them men distinguished in science and art. His memory enriches Phoenix for all time.

LIME, that is, burned or 'quick-lime', was produced in the United States to the extent of 3,663,818 tons, in 1917, this being 10% less than the production for the preceding year. The consumption of hydrated lime amounted to 719,757 tons, representing a slight increase.

Sulphuric Acid in 1917

More sulphuric acid was produced in the United States in 1917 than in any previous year. A moderate estimate shows that the increase, stated in terms of 60° B. acid, amounted to at least 600,000 tons. It is not yet possible to state accurately the production of sulphuric acid in 1917 according to strengths, for some of the companies that produce 50°, 60°, and 66° acid have reported their entire production together and so stated it as if it were theoretical 100% acid. Now, 100% sulphuric acid is above 66° B. and is here reported as 'stronger acid,' but a certain quantity of the stronger acid reported should be carried as acid having a strength of 66° B. or less. As no data are available to show the proper distribution of all the acid made in 1917, the following table has been prepared as if the reported production were the actual output:

Strength of acid	1917 Short tons	1919 Short tons
50°	2,306,372	1,829,471
60°	1,187,704	1,119,753
66°	850,006	1,580,100
Stronger acid	1,190,019	443,332

The condition of the market for sulphuric acid in 1917 is reported to have been even better than in 1916, and the value of the product was considerably higher. Some companies have had difficulty in obtaining sufficient sulphur ore and many of them have been compelled to change from pyrite to sulphur burners. Experiments in the greater utilization of pyrrhotite have been carried on and attempts have been made to find domestic deposits of pyrite that can be used if the supplies of foreign ore are curtailed under the conditions imposed by the War. The estimates given above are based on returns from the acid manufacturers received by Philip S. Smith, of the U. S. Geological Survey.

CADMIUM in a suitable proportion has been found to increase considerably the alloying capacity of lead. For instance, if there is added to a quantity of pure lead from 8 to 10% of cadmium and the two metals are fused together, and to the resulting alloy there is then added from 8 to 10% of pure manganese or of a high-percentage ferro-manganese in the molten state, a uniform alloy will be formed, which is distinguished by all the properties characteristic of the high-grade tin-white metals. It is generally possible in this manner to effect the complete absorption of the manganese by the alloy in the course of a single operation. Attention must be directed to the fact that when molten ferro-manganese is employed, little or no carbon will separate, and that both the manganese carbides and the metallic manganese will be dissolved in the other metals forming the alloys, the influence exerted by the carbides being limited to the fact that their presence imparts a greater degree of hardness to the resulting metallic alloys than would be the case were carbon-free manganese employed.

The Amorphous Minerals

By AUSTIN F. ROGERS

*The recent advances in colloid chemistry remove all excuse for neglecting the study of the amorphous state. The application of colloid chemistry to mineralogy has been pointed out by Cornu and others. More recently Mare and Himmelbauer (Fortschr. der Min., Krist., u. Petrog., III, 11, 32, 1913), have given a bibliography of the subject. Most amorphous minerals are hardened hydrogels. The water present is usually considered to be adsorbed, that is, it may have been taken up by the freshly formed colloid through solvation, though this is doubted by Robertson, but, after hardening, the water may exist in solid solution. For example, hyalite opal is apparently a homogeneous substance, and may be regarded as a true solution of water in silica. It is possible, and quite probable, that the mineral hydrogels are not properly colloids, but are of colloidal origin, and it is safe to call them amorphous. Bachmann proved, by means of the ultra-microscope, that the structure of the solid gel is extraordinarily fine. The recognition of colloidal structures in the study of minerals, rocks, and ores is important, and the fundamental differences between amorphous and crystalline minerals should not be overlooked. Also the terms colloidal and amorphous must not be confused. The term meta-colloid, proposed by Wherry for micro-crystalline substances of colloidal origin, is useful. From the standpoint of physical chemistry amorphous solids are liquids. The shape of a liquid, when unaffected by gravity, is spherical; so, hydrogel minerals are often spherical, botryoidal, stalactitic, and mamillary in form. The rounded or colloform minerals may be either amorphous or crystalline, while minerals occurring as euhedral crystals may be amorphous alteration products of original crystals, as, for example, malacon, which is a pseudomorph after zircon. Yttrotantalite, thorite, allanite, gadolinite, homolite, and yttrocrasite, all occur in euhedral tetragonal, orthorhombic, or monoclinic crystals, yet in many instances the material is optically isotropic, and the amorphous equivalents of these minerals represent pseudomorphs after the original crystalline minerals. Fibrous, lamellar, and some other structures of crystalline aggregates, do not necessarily indicate crystallinity. These may be remnants of an original crystalline condition. Pyrolusite, as one example, is probably an amorphous manganese di-oxide produced by the de-hydration of crystalline manganite. In the absence of cleavage and other direct proofs of crystallinity, optical tests are to be relied on chiefly for transparent and translucent minerals. Many amorphous substances are doubly refractive, especially colloidal crusts, the double refraction here being due to strains developed in the hardening of the gel. For opaque minerals etching is the most satisfactory. C. F. Tolman recently determined meta-colloidal chalcocite by examining polished surfaces, etched by nitric acid, with the metallographic microscope.

The chemical composition of most amorphous minerals is not as definite as that of the average crystalline mineral. Practically all of them contain water, even if the corresponding crystalline minerals are anhydrous, but the excess of water over that present as hydrion or hydroxyl is probably not essential. Thus, myeline is probably the amorphous equivalent of kaolinite, yet it contains practically the same amount of water. Among the better established amorphous minerals may be mentioned the following: amorphous carbon or schungite is a modification of carbon, and is not converted into the yellow scaly substance called graphitic acid, and it is soluble in a mixture of potassium chlorate and nitric acid; amorphous sulphur also occurs in nature; hydrotroilite [$FeS(H_2O)_x$] is a colloidal amorphous ferrous sulphide, found as a black slime in inland seas, and in some moist sands and clays; hydro-cuprite [$Cu_2O(HO)_x$] the amorphous 'tile-ore,' is found as a massive brick-red mineral associated with cuprite, which appears under the microscope as an orange-colored, almost opaque substance, in contrast to the dark red translucent cuprite; hematite presents a crystalline form, and a red earthy variety, such as the o-olitic Clinton ore, and the soft red hematites of the Mesabi range, which are amorphous, and contain a small amount of water; also a new mineral, which I recently identified, and have named cornuite, this being a glassy, green to bluish-green copper silicate [$mCuO \cdot n SiO_2 \cdot (H_2O)_x$], which is the amorphous equivalent of chrysocolla. Specimens have been found at Globe and Bisbee, Arizona, at Ludwig, Nevada, at Copper Mountain, Alaska, and at Collahuasi, Chile. It appears in colloform bands within layers of colloform chrysocolla. It is softer than its associate, and is more readily soluble in hydrochloric acid. It is probably a solid solution of cupric oxide, silica, and water.

*Abstract: 'A Review of the Amorphous Minerals;' Jour. of Geol., Vol. XXV, No. 6. Sept.-Oct. 1917.

ZIRCONIA as a refractory for lining steel furnaces has received some publicity of late. It is said to act as a neutral lining, as compared with silica or magnesite. An interesting development to which less attention has been given is the manufacture of ferro-zirconium. According to an English authority ferro-zirconium has been successfully employed in Germany for the production of zirconium steel, used for armor plate, projectiles, bullet-proof steel, and other purposes. Zirconium steels are stated to be particularly hard, such material, one inch thick, being equal to three inches of the best German armor plate. Before the War the Germans had practically a monopoly of the manufactures of zirconia, which was mainly dealt with under German patents; this state of affairs has since been changed. It is of interest to note that practically every so-called rare element has proved of industrial importance in steel metallurgy, although their influence depends largely on their effect upon the carbon in the steel.

Bauxite Products

By JAMES M. HILL

*The proving of any particular bauxite deposit is accomplished by means of churn-drill holes, or test-pits and shafts. Ordinarily, where labor is cheap, the latter method is to be preferred, as a much better idea of the deposit can be obtained. Samples are taken regularly, and in thick deposits several samples across the face should be analyzed, as the bauxite may vary in composition from top to bottom of a deposit as well as horizontally. In the northern Georgia-Alabama field prospecting is limited to the edges of the red-clay areas adjacent to quartzite ridges, for it has been shown that most of the deposits have been found in these relations. 'Dornicks,' that is, bauxite boulders, and bauxite pebbles are the signs of deposits, and should be searched for carefully. It is more difficult to prove these pocket deposits by drilling and shafts than the fairly regular horizontal lenses, for the distribution of clay and bauxite is irregular in the pocket deposits.

Owing to the presence of variable amounts of clay in all types of bauxite deposits, hand methods of mining appear to be necessary. In a few places drag-line excavators or steam-shovels are employed to remove overburden. The usual procedure in the flat-lying deposits of Arkansas and central Georgia is to strip the overburden for some distance ahead of the face of the ore. A little powder is used to break the hard upper surface of the bauxite. Hand shoveling to facilitate ready sorting of ore and waste is in vogue. In most mines cars run on temporary tracks are used, but in the smaller pits the ore and waste are transported in wheelbarrows. Seepage is ordinarily taken care of by drainage ditches, but in a few places pumps are necessary to keep the working-area reasonably dry. In the northern Georgia-Alabama-Tennessee field the conditions are different, as the bauxite is taken from pits and the work progresses downward instead of horizontally. Inclined shafts are necessary to raise the ore, as very few of the deposits are so situated that open-cuts or tunnels can be used for transportation and drainage.

Most of the bauxite of the Arkansas mines is kiln-dried before shipment, and one of the largest operators in Georgia ships only dried ore. However, a number of operators in the Georgia-Alabama-Tennessee field ship undried or 'green' bauxite. The drying equipment is simple, consisting at most places of a small wood-fired rotary kiln similar to, though smaller than a cement kiln. The bauxite is crushed and fed to the kiln with an endless chain of bucket elevator. The dried material is elevated to bins for ease in loading wagons or cars. The drying, which takes but a short time, is resorted to in order to drive off the uncombined water, which reduces the weight of the green ore 10 to 15%.

Aluminum is the most important product made from bauxite. Alum, aluminum sulphate, and chloride are the next most valuable. Artificial abrasives are third in point of value at the present time, with the refractories made from bauxite ranking fourth. There is a great difference between the value of bauxite and the products made from it. In 1910 the market value of bauxite used was approximately $780,000. From this material aluminum valued at over $7,000,000, and aluminum chemicals valued at over $2,500,000 were made. In 1916 the difference was even more marked, for the bauxite had a value of $2,300,000 and the products exceeded $42,000,000, divided as follows: Aluminum, $33,900,000; aluminum chemicals, $5,800,000; abrasives and refractories, over $2,500,000.

The Aluminum Co. of America is the only producer of the metal in the United States. It has large chemical works at East St. Louis, Illinois, and is now building a chemical plant at Sollers Point, near Baltimore, Maryland. At these plants the bauxite is treated chemically to make alumina (Al_2O_3), which is the first step in the making of aluminum. The aluminum plants of this company are at Niagara Falls and Massena, N. Y.; Marysville, Tennessee; and Badin, North Carolina. At these four plants the electrolysis of alumina to the pure metal is accomplished. The iron pots or retorts, in which this change takes place, are carbon-lined, and are equipped with adjustable carbon electrodes. The alumina is charged into a molten bath of cryolite, a mineral found principally in Greenland, which is a double fluoride of aluminum and sodium. When the electric current is passed through the charge the metal aluminum settles to the bottom of the bath and can be regularly tapped off. The operation is continuous for long periods, provided the operations are carried on properly. The installation of aluminum plants requires large capital, first for chemical works in which to make alumina, and second for the installation of power-plants to generate large quantities of electric energy. Apparently the largest problem in an undertaking of this sort is that of obtaining cheaply the enormous quantity of electric power necessary.

The average open-market price of aluminum for small lots during 1916 was 60.71c. per pound. The contract price ranged from 31 to 37c. Prior to the War the open-market price ranged from 18.63c. per pound in 1914, to 23.64c. per pound, in 1913. Alum, aluminum sulphate,

*Abstract: 'Bauxite in the South,' 'Manufacturers Record,' December 27, 1917.

and aluminum chloride are the chief salts used commercially that are made from bauxite. There are 9 plants making alum, 18 plants making aluminum sulphate, and 5 plants making aluminum chloride, in the United States. With minor exceptions, these are situated in the north. The largest plants are in Pennsylvania, New York, Massachusetts, Ohio, Michigan, and Illinois. In the manufacture of aluminum chemicals the first step is the treatment of bauxite with sulphuric acid to give a solution containing aluminum sulphate. The theory of the manufacture is, on the whole, rather simple, but numerous steps in the process make the technology appear complicated. Apparently close chemical control is required. Alum until 1915 sold approximately at $31 per ton, but in 1916 the price rose to $43; for aluminum sulphate the pre-war price was between $17 and $19 per ton, and it now sells for $29 and $30, and aluminum chloride for $70. Bauxite abrasives, such as alundum, aloxite, exolon, and lionite, are now being made by four companies in the United States, whereas before the War only two companies were producing these articles.

The installation of plants is largely dependent on the availability of cheap electric power, for the abrasives are made by fusing bauxite in a simple electric furnace. The fused mass is cooled, broken, ground, and sized. The sized material is made into a multitude of different articles, including powder, cloth, stone, and wheels. The average price received for the large output of artificial abrasives in 1916 was a little less than $70 per ton. It would appear that there is room for a considerable expansion of the artificial abrasive industry. Bauxite refractories, or closely analagous products, are made by several companies in the United States. The crude bauxite is washed and calcined at a high temperature to drive off the combined water. The calcined material is ground, bonded with fire-clay, sodium silicate, or lime, and molded. The shaped articles are dried and burned in down-draft furnaces. The price of these refractories ranges from $50 to $380 per thousand, the value being determined by the quality of the product, the bricks consisting of nearly pure alumina being the most refractory. A relatively new development in bauxite refractories is the use of fused bauxite, either in molded form or as ground or pulverized material for incorporation into refractory cements. Of this class of refractories, which are made in electric furnaces, some are pure fused alumina, and are extremely refractory, melting at temperatures of 2050 and 2100° C.

Borax in this country is used in the manufacture of enamels or porcelain-like coatings for metal utensils, such as bathtubs, kitchen sinks, cooking utensils, and the like. Fully one-third of the normal production is used in this way. Almost a third of the combined production of borax and boric acid is used by manufacturers of other chemicals. Both borax and boric acid are dispensed through wholesale and retail druggists and dealers that supply the domestic requirements, and these uses account for 25% or more of the whole production. The remaining 10% is distributed among meat and fish packers, manufacturers of glass, tanners, soap manufacturers, and potters. Price quotations show a gradual rise in the price of borax and boric acid, reaching about 7 or 8c. per pound for borax and about 12c. for boric acid toward the close of 1916. Contracts for large quantities of borax were placed during the year for 1917 delivery at 6¾c. per pound. In the open market the price for crystals granulated, in barrels, is now 7¾ to 8c. per pound.

Phosphatic Oil Shales

In its investigations of richly carbonaceous shales in the United States, made to obtain information concerning shales that may be profitably distilled for their content of petroleum when the oilfields of the country have been more fully exhausted or the prices of crude oil have become higher, the U. S. Geological Survey has sampled and tested shales from deposits of unusual interest in Montana. These deposits are not very thick, and their yield of oil is not greater than that of shales now distilled for petroleum in Scotland, but they are somewhat unusual in that the shale contains a considerable amount of phosphate as well as bituminous matter. A sample of this shale from Muddy Creek basin yielded 7.5 gal. of petroleum per ton of shale and 15.56% of phosphate, and a sample from Smallhorn canyon yielded 24 gal. of petroleum per ton of shale and 2.62% of phosphate. A brief report on these shales, prepared by C. F. Brown, has just been issued as Bulletin 661-I.

The following data showing exports of metals and ores from Yokohama to the United States, tabulated by George H. Scidmore, consul general to Japan, afford interesting information.

	1916		Jan 1 to Nov. 12, 1917	
Metals and ores	Quantity	Value	Quantity	Value
Copper ingots and slabs, lb.	2,846,066	$822,746	1,097,600	$303,656
Antimony, refined, lb.	.....	.....	1,635,864	216,751
Antimony, regulus, lb.	.....	.....	336,000	49,018
Manganese ore, tons	2,688	86,617	1,918	64,349
Ferro-manganese, lb.	.....	.....	101,331	12,174
Molybdenite, lb.	.....	.....	14,699	31,644
Molybdenum ore, tons	.....	.....	490	57,399
Ferro-silicon, lb.	.....	.....	24,640	1,785
Scheelite, tons	196	569,536	85	115,803
Ferro-tungsten, tons	.....	.....	1	4,985
Wolfram ore, tons	.....	.....	109	132,409
Zinc-dust, lb.	515,360	95,527	730,675	62,281
Iridium ore, lb.	781	31,871	.....	.....

It will be noted that Japan is retaining more of her copper, but has responded to the demand for rare metals. The trade in antimony has developed from zero to a considerable figure, and there is some movement of manganese. The Japanese have not wastefully shipped it as ore, but have taken a smelter's profit on the way.

Silver Haloid Salts, Wonder, Nevada

By J. A. BURGESS

*The halogen salts of silver at Tonopah show the chloride, bromo-chloride, and iodide occupying fairly well-marked horizons; their respective positions being downward in the order named. This sequence is explained as corresponding to the order of their deposition from percolating surface waters charged with haloid alkaline salts. It is interesting to find that the arrangement of these secondary silver minerals at Wonder corresponds to that at Tonopah, and bears out the theory advanced to explain the order of deposition at that place.

Wonder is situated in Churchill county, Nevada, about 120 miles east of Reno. The country is a complex of tertiary eruptives, including ryholite, dacite, andesite, and basalt. Of these the Wonder rhyolite is the oldest. It is a basic type of rhyolite, which, from its mineralogical and chemical composition, might well be called a quartz latite; but it has been commonly known as the Wonder rhyolite. The ore-bearing veins of the district occur in this 'rhyolite,' usually near small intrusive masses of a more acid rhyolite. They are composed chiefly of quartz and a white potash-feldspar. There are many of these veins in the district, most of which contain small deposits of silver-gold ore; but none, except the Nevada Wonder vein, has produced sufficient ore to pay for mining. The Nevada Wonder vein outcrops at the surface. It lies partly on the contact between the 'rhyolite' and an intrusive body of dacite, but toward the north the vein leaves the contact and lies entirely within the 'rhyolite.' The strike is N. 25° W., and the dip 75° E. The ore consists of quartz rudely banded with feldspar. Oxidation extends to the 1300-ft. level. The oxidized part of the vein forms the cleanest silver-gold ore, from a mining and milling point of view, that I have ever seen. The gangue is composed of quartz, feldspar with its usual decomposition products, and occasional small quantities of fluorite. It is stained yellowish brown with limonite, although some of the ore is white. The silver is in the form of argentite and halogen salts, and the gold is both native and combined with the argentite. Oxide of manganese occurs only in small dendritic forms, except in unimportant local concentrations. Copper and lead occur only in traces. No zinc was found above the 1300-ft. level, and there is practically no arsenic or antimony.

The silver haloids found were embolite, iodobromite, and iodyrite, which are respectively the bromo-chloride, iodo-bromo-chloride, and iodide of silver. No cerargyrite was seen. As at Tonopah, the percolating waters contained the alkaline salts of chlorine, bromine, and iodine, which caused the selective precipitation of corresponding secondary silver minerals in separate horizons. There was this difference, however, that while at Tonopah the silver took the form of chloride, bromo-chloride, and iodide, at Wonder it took the form of bromo-chloride, iodo-bromo-chloride, and iodide, the order being downward as named. The best example of this was in what is known as the Extension ore-shoot where embolite was found to a depth of 950 ft. and iodobromite from that depth to the 1300-ft. level. Iodyrite was found in limited quantity and in collectible amount only in one locality on the 1000-ft. level, where, in a hanging-wall branch of the vein, there was an unusually rich deposit of silver sulphide which had been shattered and partly oxidized. Iodobromite occurred in films and crystallized coatings throughout this mass, among which were some pretty specimens. At the lower limits of this enrichment, a small pocket of loose iodyrite crystals was found lying immediately under rich fragments of ore. As at Tonopah, jarosite, the hydrous sulphate of iron, was prominent among the decomposition products associated with the iodyrite. It will be observed that, although this iodyrite was not found at the lower limit of the iodobromite zone, it was in a channel separated from the main body of the ore. In this position the rich ore had the effect of intensifying the precipitation of the chlorine and bromine and reducing their concentrations, until the solution was sufficiently weak in these elements to permit the precipitation of the iodide. In the main vein, however, the iodobromite zone extended to the lower limits of oxidation at the 1300-ft. level. While the iodide was uniformly precipitated separately from the chloride and bromide at Tonopah, it was, with the trifling exception noted, precipitated in combination with them at Wonder. The reason for this is apparently that the percolating solutions in the two places contained different concentrations of the chlorides, bromides, and iodides. Emmons says:[1] "If, in a solution containing the three halogens, chlorides are vastly in excess, silver chloride will be precipitated first, even if bromides and iodides are present, for, in a mixed solution, the least soluble salts are not precipitated first, if a more soluble salt is present in sufficiently great concentration."

Evidently the concentration of chlorine was less in proportion to that of bromine and iodine at Wonder than it was at Tonopah. The minerals associated with these halides were the quartz and feldspar of the vein with their usual decomposition products, limonite in com-

*Abstract: 'Economic Geology', Oct.-Nov. 1917.

[1]William Harvey Emmons, 'The Enrichment of Sulphide Ores,' Bulletin 529 U. S. G. S., 1913.

paratively small amount, manganese dioxide in small amount, and wulfenite. The last occurred in small amounts in the iodobromite zone, though there seems to be no obvious connection between the two. As previously mentioned, flaky jarosite occurred with the iodyrite, but not noticeably elsewhere. It is noteworthy that no pure bromide of silver was identified either at Tonopah or Wonder.

The source of the halogen salts of the alkalies appears to be in the salt lakes that formerly existed in this region. Alkali flats, and salt beds of commercial importance, lie within 25 miles of Wonder. As far as I have been able to ascertain, the accumulations of salt in the Great Basin have not been tested for iodine or bromine, but George Otis Smith has informed me that bromine was detected in the brines from Searles Lake, California. Doubtless, close analysis would show that they exist in practically all of these accumulations of salt.

Embolite, Ag(BrCl), occurs as grayish-green, waxy, translucent coatings and groupings of deformed crystals adhering to the ore. Where the mineral is abundant, it is sometimes found in the form of loose crystals, often of cubical form, lying in cracks and openings. It is often associated with wulfenite. It has a perceptible odor of bromine. It is sectile and has no cleavage. The symmetry is isometric.

Iodobromite, 2AgCl, 2AgBr, AgI (Dana), the iodobromo-chloride, occurs as light to dark olive-green, translucent, lustrous, crystalline coatings, and loose imperfect crystals. Crystal-surfaces have a brilliant lustre. The mineral has no cleavage and is sectile. It is associated with a small amount of wulfenite and an occasional loose crystal of iodyrite. The odor of bromine is apparent. The symmetry is isometric but perfect crystals are rare.

Iodyrite, AgI, the iodide, is found in pockets of loose sulphur-yellow crystals in cracks and cavities in the ore, and in occasional crystals associated with iodobromite. The symmetry is hexagonal hemimorphic. The mineral is sectile and has well-defined cleavage. It has a distinct odor slighly milder than that of iodobromite or embolite. The odor of these minerals, as a class, is one of their most distinctive characteristics, though I do not know that it has been mentioned before in print. It is best described as a drug-store or laboratory odor, reminding one strongly of the characteristic odors of those places, and is not as rank as the odor of chlorine or bromine gas. Of the specimens that I have at hand, embolite and iodobromite smell alike, though iodobromite is the stronger. The smell of iodyrite is milder and less penetrating than that of the other two. The odor of these minerals is sufficiently strong, so that on entering stopes where a deposit had been newly found, I have frequently been made aware of its presence through the sense of smell.

Under the recently enacted revision of the Texas mining law claims covering mineral deposits not occurring as lodes may consist of four sections, or about 2400 acres, on which the usual assessment work must be done, and a royalty must be paid to the State.

Tariff Commission Asks for Data

The Tariff Commission is making an inquiry into the significant developments that have taken place in the chemical industries since the passage of the tariff act of 1913. Changes which seem likely to alter permanently the conditions of international competition or the course or volume of foreign trade are of special interest. All persons having direct knowledge of pertinent facts in regard to any particular industry or product are invited to submit a statement to the Tariff Commission. Among the matters on which the commission desires information are:

1. The manufacture within the United States of articles formerly unavailable or obtained exclusively by importation; for example, phosgene.

2. In the case of industries previously established in the United States, the erection of new plants or increase in capacity of existing plants; for example, the increase in capacity of existing plants for making caustic soda and chlorine.

3. The future of industries newly created, or in which productive capacity has been greatly increased to meet a direct war-demand. How can these plants be utilized when the war-demand disappears?

4. Any general or significant differences in the prevailing methods of manufacture here and abroad.

5. Differences in the organization of the industry here and abroad.

6. The development or invention in the United States or abroad of new or improved processes which are likely to influence the conditions of international competition; for example, the hydrogenation of fatty oils or the flotation process for concentrating ores.

7. Significant changes in the conditions of international competition caused by the recent law making patents owned by citizens of enemy countries available to American manufacturers.

8. Industries which have been seriously hampered in their normal operation or development by difficulty in securing materials or supplies formerly imported; for example, the lack of potash for fertilizer or glass. If these difficulties have been met by the introduction of substitutes, is it expected that there will be a return to the old materials and methods when foreign supplies again become available, or will the changes be permanent?

9. Developments or changes in other industries which have created a new or greatly increased demand for chemical products; for example, the manufacture of new varieties of glass.

10. The discovery of new uses of materials, creating a new demand or furnishing a market for materials formerly wasted; for example, the use of aniline as an accelerator in the vulcanization of rubber.

11. Any governmental hindrances in the United States or abroad, either in manufacture or commerce; such as the export duty on nitrate from Chile.

The commission will publish only general statements or summaries, which will not reveal the operation or plans of individual companies.

REVIEW OF MINING



NEW YORK

WEATHER CONDITIONS BETTER.—STOCKS AND BONDS.—COAL, GAS, AND ICE.—POSTAGE RATES.

A return to more favorable weather conditions gives promise of a resumption of normal activity in the near future. The effects of the recent legalized disorganization in industry are only now being realized in some phases of business. Reduced income means reduced buying and more cautious expenditure. Delivery delays have led to repudiation of contracts, and other effects are observable. Clearing House figures show a decrease of about 24% in the amount of payments through the banks in New York City, as compared with the corresponding week last year. This may be taken as an estimate of the dislocation caused by the recent state of chaos.

The stock market shows a continuous diminution in trading, with no marked change in average quotations. Bonds may be divided into two classes, namely: Liberty bonds, and the rest. The latter have appreciated in value for the most part during the week. Liberty bonds, on the other hand, have again reached low records, the 4% issue at one time touching 95.10, thus showing a loss from par of $49 per $1000. A bill has been proposed which would set aside a sum not exceeding $60,000,000 for the purpose of stabilizing the price of these bonds. The fund would be used to purchase for cancellation any bonds that might be offered at below-par rates. In has been stated that the method is in successful operation in France and England; and that the British Treasury only spent $132,000,000 from its stabilizing fund last year to prevent slumping of war bonds. New York financial opinion claims that the $60,000,000 fund suggested would be altogether too small to have any appreciable effect on the downward trend of the market.

Thanks to a more moderate temperature the coal situation is improving. Eastern railroads show less congestion and haulage is rapidly assuming normal operation. The Monday closing order has been rescinded for several Southern States, but still remains in full force in New York. Yesterday the offices in many buildings without artificial heat maintained a comfortable temperature, but the order strictly enjoins that not even one elevator shall run, so that all business was successfully killed. In some quarters it is considered that the coal shortage is in part due to the fact that heavy shipments of coal have been made to our Allies in Europe. This is far from being the case. Great Britain exported $256,700,000 worth of coal and coke during 1917; and was able, during the past week, to relieve the local fuel famine to a slight extent by the transfer of a cargo of coal held here and consigned for bunkering British ships. The reduction in quality of present coal consignments has been explained by the fact that, as long as prices remain fixed, coal miners will work only the inferior grades and the most accessible deposits.

The unprecedented demand for gas during the recent coal shortage was fully met by the various companies whose facilities to meet an abnormal situation calls for the highest commendation. During January the city consumed 6,650,315,700 cu. ft. Some companies were able to meet a 60% increased demand.

The possibility of an ice famine next summer having been duly realized, natural and artificial-ice manufacturers conferred on the possibilities that might arise out of such a situation. An amicable agreement was reached, and the harvester companies decided to cut an extra 1,000,000 tons, forgetful of the circumstance that a short time ago it was decided to insist that there was no available labor, no storage facilities, and the ice was too thick anyway. Their patriotic action in endeavoring to minimize future distress has been eulogized, but the decision was so coincident with the news that an Ice Controller was to be appointed that their action was perhaps of not so disinterested a nature as was first thought. The new Ice Controller will be authorized to cut up to 2,000,000 tons for subsequent sale, and an adequate appropriation will be made for this purpose. The action of the authorities in this matter is a subject for favorable comment.

New York City possesses 14 postal districts and the same number of general post-offices. Letter postage from Manhattan to Brooklyn is the same as from Manhattan to San Francisco, and the same three-cent rate applies to all interborough postage. The two-cent rate applies only to 'drop letters,' that is, letters mailed in the same district in which they are to be delivered. A bill for the uniform two-cent rate throughout the city is under consideration and would command general approval. The Chamber of Commerce, in support of the scheme, shows that a two-cent rate prevails in all the Boston post-office districts. The penalizing of New York in this respect would seem entirely unreasonable and partial.

CRIPPLE CREEK, COLORADO

UNITED GOLD MINES.—EL PASO LESSEES.—MODOC CONSOLIDATED.—CLYDE AND ROSE NICOL MINES.

Producing mines of the United Gold Mines Co.—Trail, Bull Hill, W. P. H., Ironclad Hill, Bonanza, Battle Mountain, Wild Horse, also Damon dump on Ironclad hill—yielded 2100 tons of $20 ore during January. The Trail, with four sets of lessees, yielded 1710 tons.

Cripple Creek Deep Leasing Co., operating the Jerry Johnson mine, sent out 500 tons of 1-oz. ore in January, mined from above the 850-ft. level.

Lessees—12 sets—of the El Paso Consolidated Gold Mining Co. forwarded 500 tons of $18 ore to the Golden Cycle mill at Colorado Springs in January. The company is still inactive.

Modoc Consolidated Mines Co. is mining good ore on No. 15 and 16 levels of the Modoc incline, 80 tons shipped last week returning $30 and $35 per ton.

The Millasier Mining Corporation is cutting a station at a depth of 1450 ft. of the Clyde, on the north-east slope of Battle mountain, and the superintendent, Charles Fish, has started to cross-cut for the Clyde vein this week.

Ore has been cut on the 800-ft. level of the Rose Nicol shaft on the north-west slope of Battle mountain, and shipments will soon be made. The mine owned by the Rose Nicol Gold Mining Co., is under 6 years' lease to the Camp Bird Mining, Leasing & Power Company.

Dissolution notices of the Rubie Mining & Leasing Co. and Peggy Leasing Co. have been filed for record with the clerk and recorder of Teller county.

The Vindicator Consolidated meeting was held February 14.

PLATTEVILLE, WISCONSIN

FACTORS HINDERING ZINC MINING.—ZINC, LEAD, AND PYRITE PRICES.—NEW PLANTS.—POWER RATES.

Snowstorms in January made conditions bad for February, and the first half of this month found producers contending against wretched roads, scarcity of cars, low temperatures (at one time 30° below zero), and lowering prices for zinc ore. These factors resulted in the first 15 days showing a maximum output of zinc ore of about 50% of normal. Lack of fuel compelled power companies to curtail output, working schedules being sadly disorganized for days at a time. Train schedules were totally abandoned for days, and in the northern part of the field even mail service was discontinued for the first five days. In the Pecatonica and LaFevre River valleys, where are many of the best zinc mines of this region, managers took precautions against thaws and the possibility of flooded workings. Mines removed some distance from railroad, and compelled to transport ore by team or auto-truck, have been hindered from making deliveries, but bad as conditions are, it is freely admitted that a long period of idleness is sure to be forced on operators when the spring break-up comes a month hence. The entire field is covered with a mantle of ice and snow in places house-high, and a long season of fair weather will be required to first remove the snow banks, and after that the muddy roads.

Prices for zinc ore were discouraging. The base on first-grade ores on February 1, namely, $62 per ton, receded to $60, with the range down to $50 on second and medium-grade ores. Less latitude was allowed on the lower grades, the line being drawn on assays not lower than 54% zinc content. On ores under 40%, the bulk of which finds its way to separating plants in the field, discrimination was decidedly sharp, and offerings became so unsatisfactory that reserves piled up in all the districts where low-grade producers predominate.

Lead-ore producers had more reason to be joyful, as offerings held firm the first 15 days of February on a base of $85 per ton, 80% metal content. Sellers refused to sell until offers returned to $100 per ton, and only 74 tons cleared in the first two weeks. The curtailed output of zinc ore is attended with a smaller yield of lead ore, so that no great appreciation in stocks is shown; but it is now estimated that there is 3000 tons of choice lead ore held in bins in the Wisconsin field.

Sale of iron pyrite was stimulated somewhat during the period by reports from Washington, D. C., of the immediate commandeering of sulphuric-acid supplies by the Government. Producers at liberty to sell on open-market quotations secured better figures than usually prevail, but the bulk of sales made sold off under contract arrangements much to the openly confessed displeasure of refiners so bound. The reserve in the field is conservatively estimated at 5000 tons.

A new 500-ton mining and milling plant was completed for the Wisconsin Zinc Co. at the Copeland mine in the Shullsburg district. The plant proved satisfactory from the start.

Another 600-ton power, mining, and milling plant completed for the Vinegar Hill Zinc Co. on the Jefferson mine, in the Hazel Green district, was placed on a double-shift schedule. It is claimed the new producer is capable of yielding a car of zinc concentrate daily.

In the Galena district more interest is being shown than for many years, following numerous strikes of both zinc ore and lead ore near the city limits.

The Blewett Mining Co. was organized under the laws of Illinois, with a capitalization of $100,000. The Burr Mining Co. of Benton, Wisconsin, a successful producing corporation for the past three years, is financing the new undertaking, and plans have been drawn for a new 500-ton concentrator, the work to be started with fair weather. Drilling operations followed over a period of several months resulted in the blocking out of a big zinc deposit in places 30 ft. thick.

The burning of the White Rose mine plant, one of the Gus E. Brown producers, entailed a loss of $15,000. This followed a rich discovery of lead ore, nullifying for the time its value. Miners are engaged in hoisting the ore and hand cleaning is resorted to until the plant can be re-built.

An announcement by the Inter-State Light & Power Co. of Galena of an increase in power rates was promptly met by a protest filed by operators with the State Industrial Commission. Legal talent was promptly employed by both principals, and a hearing was held before the Commission lasting more than a week. The matter has been taken under advisement, and until a decision has been rendered the rates in effect prior to the announcement will continue to prevail.

The Lawrence Mines Co. of Dubuque, Iowa, now in control of the Indian Mound mine at Benton, has acquired valuable mineral leases in the New Diggings district, and a local office has been established at the latter place. The new lands will be thoroughly explored with drills, and mine development is proposed on a large scale. The Indian Mound mine, for years an indifferent producer, under the new management has developed into one of the best single producers in this district, and it is claimed will be fully opened in the coming spring. The Lawrence mine in the Hazel Green district, operated for several years, has been permanently abandoned.

The McMillan Zinc Co., fully equipped, has, after two years work, shut-down temporarily. High cost of labor and supplies and an exceptionally heavy flow of water compelled the stoppage. More capital is required to bring the McMillan to a producing basis. It is claimed by the promoters that a large body of zinc ore has been proved, and only cash is necessary for profitable results.

SUTTER CREEK, CALIFORNIA

CENTRAL EUREKA.—KEYSTONE REPORT.—ONEIDA.

Shaft-sinking is to be resumed at the Central Eureka mine during the present week and active preparations for the work are now in progress. It is believed possible to keep 30 stamps dropping on ore from the 2500 and 2700-ft. levels until the shaft is sunk another 500 ft. The present depth is 3450 ft., and there are excellent indications that veins apexing on the present lowest level will yield handsomely at increased depth. The equipment recently has been inspected and brought to comply with boiler-safety rules; arrangements have been made to increase the use of compressed air as an auxiliary for steam. Fred Jost is superintendent. Semi-annual report of the Keystone company shows that the 40-stamp mill lost only 2½ days in the six months ended December 31. During that period 43,151 tons of ore was crushed, yielding bullion to the value of $7781 and concentrate worth $107,374. After deducting freight and smelter charges of $24,548, there is an income from ore sold of $90,606, or about $2.10 per ton. Despite the low grade of the ore milled, a profit of $5634 is recorded for the six months. The three lower levels, 1200, 1400, and 1800-ft., each produced from 11,000 to 12,000 tons of ore, while the 900-ft. level is credited with a production of 2896 tons and the 1000-ft. level with 5636. A shaft station is now being cut at the 2100-ft. level. The vein formation cut in sinking the shaft gives promise of this level producing better ore than levels above, and the intention is to cross-cut east and west at this point. The work to the east is for the purpose of cutting the vein worked in the level above and that to the west having as its object the prospecting of the Mother Lode slates, so strongly in evidence on the 2600-ft. level. This work will prove the ground about midway between the bottom of the old workings and the ground exploited from the 2600-ft. or lowest level of the mine. Several months will doubtless be required under present conditions to thoroughly prospect this ground. A raise is being driven from the 900-ft. level and, at the present height of 95 ft., shows a large body

of low-grade quartz. Stoping is in active progress on the 1000-ft. level, 500 ft. north of the shaft and from two stopes on the 1200-ft. level. While no driving has been done on the 1400-ft. level for several months, a large tonnage of milling ore is in course of extraction from stopes above the foot-wall drift, north of the shaft. Driving is in progress both north and south on the 1800-ft. level; the work to the south having opened a large tonnage of ore and prospects being excellent in the work to the north. Carlton R. Downs is superintendent of this property, which has been in almost constant operation since its discovery in 1851. Miners are pleased with the rainfall, as the power company had notified the mines in Amador county that lack of snow on the summit would render it necessary to cut off the supply of electricity and water within the next few days. The present storm here, which means increased snow in the mountains, will doubtless prevent a serious shut-down of the mines.

DEADWOOD, SOUTH DAKOTA

MINERAL PRODUCTION OF BLACK HILLS IN 1917.—NEW PLANTS ERECTED AND BEING BUILT.

Gold bullion production of South Dakota in 1917 was valued at $7,518,333, extracted from 1,860,904 tons of ore, according to the annual report of the State Mine Inspector. Producers were as under:

Producers	Tons	Value
Homestake	1,670,476	$6,636,622
Trojan	113,121	471,268
Golden Reward	33,328	198,040
Mogul and Ofer	35,980	187,317
Homelode	450	1,850
Columbia	64	3,484
Bismarck	2,325	3,720
Elk Mountain	3,120	9,216
Monarch	28	922
Placer	.....	1,000
Miscellaneous	10	4,893

Gold output for 1917 is only slightly below that for 1916.

There was also produced 267 tons of tungsten concentrate valued at $320,009. Most of this was taken from the Homestake, although Wasp No. 2 made one shipment.

Lead-silver mines were more active than for some years, and 267 tons of ore was shipped, valued at $6695. Most of this was from the Galena district, only 20 tons coming from the southern hills.

Tin operations resulted in an output of 22 tons of concentrate worth $8200. This was recovered at Hill City, while small amounts of stream tin were obtained in the Tinton district.

Of mica 321 tons was shipped from Pringle and Berne, valued at $9259.

Lithia ore, 1281 tons, valued at $25,620, was shipped from the Rheinbold and Standard Essence properties at Keystone.

Eighty tons of copper ore worth $1888 was shipped from the Black Hills, Blue Lead, and Southern Queen properties in the southern hills.

In addition to the minerals mentioned there were produced pyrite, manganese, coal, kaolinite, gypsum, limestone, and structural materials, and the value of all, including those mentioned above, is placed at $8,201,448.

Employees numbered 2757, compared with 3069 in the previous year. There was a noticeable decrease in underground workers. Seven fatal accidents resulted from mining operations.

New plants were completed during the year by the following companies: Homestake, power-plant; Homelode, amalgamation-concentration mill; U. S. Gypsum Co., 100-ton plaster mill; Dakota Plaster Co., 180-ton plaster mill; Refinite company, plant for kaolinite treatment; and Custer Peake, 10-stamp mill and concentrator completed. Under construction are Spokane Lead & Silver, 100-ton concentrator; and Deadwood Lead & Silver, 10-stamp mill and concentrator.

LEADVILLE, COLORADO

CAR SHORTAGE.—PYRITE DEPOSITS.—SILVER DISCOVERY.—STUDY OF MATCHLESS GROUND.—ROY AND GREENBACK DEVELOPMENT.—MANGANESE.

Ore production of this district is being seriously handicapped by the continued shortage of railroad cars and the inability of the Colorado & Southern to handle its end of the business. Mines that secure service from this road are without empty cars half of the time. One company that normally loads three 60-ton cars per day has had only five cars in two weeks. The other roads, although often without the required number of cars to supply their demands, are giving fairly good service.

The Leadville Unit of the United States Smelting, Refining & Exploration Co., operating the Harvard, Tip Top, and Jamie Lee shafts on Fryer hill, has just made the most important discovery in its development here. An immense body of iron pyrite has been found between the Denver City and Jamie Lee shafts, and from 100 to 150 tons daily is now being shipped. The pyrite carries silver.

A new ore-shoot, which promises to be the largest yet found in the mine, was discovered on February 10 in the Bartlett on Sugar Loaf. The ore shows considerable ruby silver. The shoot occurs in the same big fissure that was cut late in 1916, when the first important discovery was made. Last year $30,000 in silver ore was extracted from the vein, but the ore-shoot pinched out, and for several weeks the lessees have been driving through a barren section. Operations at the Bartlett are done through a winze that is down 50 ft. below the main tunnel-level, which is 300 ft. from surface. Both the first ore-shoot and the body just opened extend under the present workings from the winze, and the lessees propose to sink another 50 ft. The winze is equipped with a 250-gal. electric pump and a 37-hp. hoist.

Efforts of Edward Huter, manager for the Matchless Mining & Leasing Co., to find the second contact in Fryer hill, have so far been unsuccessful. Matchless No. 5 shaft has been sunk through the parting quartzite, which was 25 ft. thick, and has been continued in the underlying porphyry an additional depth of 68 ft., giving the shaft a total depth of 350 ft. At this point the bottom remained in porphyry, with no apparent indications of any change in the formation being at hand. Sinking has been discontinued, and further prospecting below will be done by diamond-drill. It is believed that the white lime exists under the porphyry, forming the second or sulphide ore-zone that for years has been an unknown and alluring factor in Fryer Hill development. Work at the Matchless is important in that it will demonstrate beyond doubt whether or not a second contact really exists. Sinking at the Hayden shaft on Yankee hill, which was undertaken last year, failed to penetrate the lower porphyry, but an underlying lime was encountered at the Jamie Lee shaft of the Leadville Unit. No mineralization was found, however.

Heirs of the Thomas F. Walsh estate are planning to extensively develop a large tract of ground known as the Roy group on Canterbury hill. This area was one of the first possessions of the late Mr. Walsh, but owing to his numerous other holdings he was able to complete only a small amount of development in it. The property is in line of the proposed Prospect Mountain tunnel, and is thought by local people to be on the extension of several large veins that traverse the Fryer Hill territory across the gulch. Work will probably be started early in spring, as the agents for the estate have been here inspecting it and are securing prices on machinery.

The owner of the Greenback shaft, Patrick Mulrooney, is again draining his property to the bottom level, a depth of 1350 ft. During the past few months development in the Greenback has been confined to the area extending above the 1100-ft. level, and the water was allowed to rise to that point. Orebodies on the 900, 1000, and 1100-ft. levels have been opened, and a regular tonnage of good ore is being extracted. Larger and richer deposits are known to exist below and the work of reaching them is now in progress. Electric and steam-pumping equipment has been installed.

G. P. Goodier of Denver has purchased the Jason lease on Poverty Flats from Mrs. Florence Doty, also of Denver, for $10,000. For several years the Jason has been a continuous producer of iron oxide, carrying silver and manganiferous iron; and at one time was credited with an output of 100 tons daily. Early in 1917, when the demand for domestic manganese ores caused Government investigation of all the known manganese sources of the country, the Jason was one of the first properties in the Leadville district to be listed. At that time it was shipping steadily to the Colorado Fuel & Iron Works at Pueblo, and a large tonnage was blocked out in the mine. The material was rated as high-grade manganese, averaging 30% manganese and less than 10% silica, and it was not long before Eastern buyers were bidding for the ore. During the past year several lots were shipped East and brought good returns; but the recent traffic complications caused the Jason operators to again ship their entire output to Pueblo. At the present time, two distinct deposits of manganese are being developed in the Jason. Both of these occur on the 250-ft. level, and have been opened for several months. Measurements made just prior to the sale showed one body to be 22 ft. long and 17 ft. wide, the other 16 ft. long and 11 ft. wide. The top of these deposits has not been reached. Under existing conditions, which place a premium on manganese ores, the Jason product is unusually fine. The ore carries as high as 34% manganese and has a silica content of from 5 to 6%. Mr. Goodier, the new owner, is preparing the property for a greatly increased production, and may contract with Eastern buyers who offer high prices for the ore. Beginning March 1, the property will ship 50 tons daily.

ELY, NEVADA

FUEL.—CONSOLIDATED COPPERMINES.—NEVADA UNITED.—TUNGSTEN.—WILLOW CREEK.—MANGANESE.

Coal conditions in the Ely district are better than for months. The Nevada Northern railroad and the Nevada Con. Copper Co. have 40 to 50 days' supply. Both have discontinued running their own cars to Utah coal mines. Coal and wood yards here have good stocks. The exceptionally warm winter has been a great help to the fuel situation. The Nevada Consolidated is keeping up its regular production.

The Coppermines company continues its development policy. It expects to be able to re-start its 1000-ton experimental mill on March 1. This has been closed for repairs and mine development since January 1. The power problem is serious. The nearest hydro-electric power is obtained near Round Mountain, Nye county. Recent estimates of delivering power here is $600,000, and the Federal authorities object at this time. The Nevada Consoldated could furnish it by increasing its steam-generating plant at a minimum outlay, but is prohibited under State laws, as the company is classified, when selling power, under the General Utilities Act.

The Nevada United company (old Ward mine) is shipping 30 tons daily of lead-silver ore with an iron base, as fluxing ore to Utah smelters. Development continues satisfactory.

O. E. Roodhouse, formerly superintendent for the U. S. Tungsten Co., 12 miles south of Osceola, is dismantling machinery in the mill and shipping it out.

William Stewart is employing a few men at the Minerva scheelite property, a few miles south of the U. S. company's mine.

A. R. Shepherd, manager of the Tungstonia Mines Co., is milling a little ore.

The Red Hills lead-silver mine, in the north-eastern part of White Pine county, is being developed under bond and lease.

The Willow Creek gold camp, 100 miles south-west of Ely, is again in the limelight. Recent development has found the original surface discovery shoot of high-grade ore at 100 ft. depth. While there is several feet of good milling ore, there is a shoot about two inches thick, said to be fully one-fourth free gold. It is estimated that there is from $75,000 to $200,000 of gold in this shoot.

The Liberty Gold company, a Salt Lake City, concern, operating near the first discovery of the district, on one made last year, has a good showing.

Manganese mining is becoming active in the Ely district. Holmquist and Bowen, 7 miles south-east of Ely, are shipping 20 to 25 tons daily. Development at 60 ft. has opened a large deposit of 60% ore, according to the owners, who refused a fancy cash price for the mine. Italians on adjoining property are shipping 10 tons daily. A. B. Witcher has just shipped his first carload from a discovery within ¾ mile of the courthouse. Others are leasing claims and mining manganese.

TINTIC, UTAH

GEMINI AND GODIVA COMPANIES.—DRAGON FLUX ORE.—ZUMA DEVELOPMENTS.

Shareholders of the Gemini Mining and Godiva Mining companies met on February 5 in annual session and elected directors for the ensuing year. The two companies are under the same management, and the officials are practically the same. The Gemini re-elected as president, E. W. Packard; vice-president and manager, J. C. McCrystal; treasurer, E. O. Howard; secretary, J. E. Berkley, who, with W. V. Cott, are directors. Preliminary reports were submitted. That on the Gemini covered 14 months, up to December 31, 1917. Dividends totaled $130,000, of which $100,000 was paid in 1917. Gemini shipped 489 carloads of ore, or about 24,000 tons, in 1917. The Godiva shipped in January 1918 one carload, or 50 tons; and the Gemini 32 cars, or 1500 tons. In 1917 the Godiva shipped about 1200 tons. Smelter embargo and shortage of cars kept the McCrystal mines from recording a much larger tonnage of ore during 1917.

During December the Dragon Consolidated shipped 8000 tons of ore, also a similar amount in January, and probably the same will leave the property during February. While much of this output is an iron product of rather low grade which is in demand at this time, the Dragon is producing considerable ore—silver, lead, and copper. It is understood that the smelter desires a large tonnage of fluxing ore from this mine, and the present output could be increased if more care were available. Earnings of the Dragon have been entirely satisfactory for many months. One of the most important explorations under way is sinking a winze from the 1000-ft. level. It is down 600 ft., and 150 or 200 ft. additional sinking will be done before cross-cutting is started. This winze will prospect virgin ground.

Reports from the Zuma are encouraging. The winze started from the 500-ft. level to follow a shoot is 80 ft. below the level, with sinking still in progress. The winze has been in ore all the time, although the shoot has varied in size. A drift is being driven along the vein on the 500-ft. level, where there is another good shoot. The management is confident of being able to bring the property into the productive stage during 1918.



ALASKA

Fairbanks.—Early in February fire destroyed the roundhouse and machine-shop of the Government railroad at Nenana. Besides the loss of $75,000 to $100,000 of property, progress will be considerably hindered.

Juneau.—Gold yield of Alaska Gastineau in January was the lowest on record, being 179,300 tons of ore assaying 90.3c. per ton. The recovery was 77.85%.

Kennecott.—Copper production of the Kennecott company in January is given as 12,170,000 lb., of which about half should be credited to Braden in Chile.

Valdez.—An aerial tram, 28,360 ft. long, has been erected by the Riblet Tramway Co. of Spokane for the Granby Consolidated company at its Midas mine. The tram is the largest in Alaska. It is divided into six sections, with a total of 77 towers. The largest span is 3080 ft. The cable for loaded skips is 1¼ in. diameter, and for empties ⅞ in. Eighty buckets of 1000 lb. capacity each are in use. The cost complete was $3.66 per foot, and cost of operation 0.328c. per ton carried.

ARIZONA

Cochise County

Bisbee.—Calumet & Arizona produced 4,748,000 lb. of copper in January, compared with 4,054,000 lb. a year ago, and 5,816,000 lb. in December.

Shattuck-Arizona in January produced 849,440 lb. copper, 84,000 lb. lead, 9599 oz. silver, and 106 oz. gold; against 1,415,303 lb., 425,638 lb., 19,105 oz., and 211 oz., respectively, a year ago; but an improvement on the December output.

Douglas.—A new record was made in January at the Copper Queen smelter, production being 21,700,000 lb. of copper, against a little over 2,000,000 lb. in December. Besides the ores mined from the Copper Queen at Bisbee, this yield includes ore sent from other mines owned by the Phelps-Dodge interests, such as the Burro Mountain Copper Co. at Tyrone, New Mexico, and Moctezuma Copper Co. at Nacozari, Sonora. Considerable custom ore is also treated, one of the principal shippers being the United Verde Extension in the Jerome district.

Globe.—Copper production of the Old Dominion company in January was 3,400,000 lb., against 3,000,000 lb. a year ago, and 3,368,000 lb. in December.

The Employees Committee of the Old Dominion company recently petitioned the management for a company store, stating that the general prices of the Globe merchants are too high as compared with those in other communities. There were 832 signatures to the petition. When asked about the matter, W. G. McBride, general manager for the company, said: "I have taken the matter under consideration and intend to make a thorough investigation of the question, and to secure all the data possible before making any recommendations. The company does not wish to enter into competition with the merchants of Globe, but it is very anxious to have its employees secure the essentials of life at reasonable rates. I will not recommend my company to go into the mercantile business here unless the results of my investigation go to show that local merchants are charging unreasonable prices. If, however, I find the men are being unfairly treated and that the evil cannot be remedied in any other way, I will certainly use my influence to have our company start a store or commissary. However, I feel that there are quite enough stores in Globe now to supply the needs of the community and I hope that the business men will co-operate with the company and its employees to the end that the cost of living may be kept as low as possible."

Miami.—Copper production of Inspiration Consolidated in January was 5,000,000 lb., against 5,600,000 lb. in December., and 11,600,000 lb. a year ago.

Maricopa County

Wickenburg.—The Rich Hill Gold Mining Co. has been incorporated to work the old Johnson gold mine on Rich hill. E. C. Lane is in charge.

Pima County

Ajo.—Copper production of New Cornelia in January was 4,136,000 lb., against 3,850,000 lb. in December, and 4,660,000 lb. in November.

Pinal County

Superior.—Fortuna Consolidated Mining Co., operating in the Magma district, reports cutting ore assaying 125 oz. silver and 7% copper. An adit is being driven on a small north and south vein to intersect a large east and west vein system, supposed to be an extension of the vein which the Magma and Silver King mines are operating. The east and west vein has not yet been cut. The adit is in 900 ft. and shipping ore a foot wide has been found. It is expected that the adit will open a large orebody at the intersection of the two veins, as the Magma found its orebody at a somewhat similar point.

Yuma County

Swansea.—The Argus copper mine, adjoining the Planet, has been taken over by Ernest C. Lane, formerly in charge of the Swansea mine, and active development will be started at once. A large hoist, compressor, pumping-plant, and other necessary machinery to sink the shaft to a depth of 500 ft. is now on the ground, and will be installed at once.

ARKANSAS

Sebastian County

Fort Smith.—The Fort Smith Spelter Co. has resumed smelting, after being shut-down since November 6. Four blocks, with a total of 2560 retorts, are now at work; also about 200 men.

CALIFORNIA

Amador County

Sutter Creek.—At the Old Eureka mine the shaft is down 2165 ft., with sinking proceeding at 17 to 20 ft. per week. The shaft will be sunk 1000 ft. deeper. Some good ore has been opened at 1600 to 2100 feet.

As money could not be secured for development, the South Eureka company may suspend work at its South Eureka and Oneida mines.

Inyo County

Bishop.—Three tungsten mills are at work in this district, another is ready for operation, while construction of a 150-

ton plant at the Beauregarde is to be started soon. The monthly payroll of the tungsten properties is $30,000.

KERN COUNTY

Randsburg.—On February 22, 23, and 24 a convention is to be held here by the District Miners and Claim-Owners. Its purpose is to form an organization devoted to the mining industry of Kern, Inyo, and San Bernardino counties, to secure recognition by kindred organizations, also co-operation among large and small mine operators throughout the district, and keep them advised of the work of the American Mining Congress, to watch National and State legislation affecting mining interests, etc. R. E. Rose is secretary.

The Yellow Aster company is busy developing its recently-acquired Black Hawk gold claims. A 17-in. shoot is being opened.

NEVADA COUNTY

Grass Valley.—A new compressor and pumps were started at the Delhi last week, and unwatering is under way. A considerable amount of surface improvement has been done. A. A. Codd is manager of this property, which is near Columbia Hill.

SIERRA COUNTY

Alleghany.—Mining in this county is reported to be quiet this winter, largely due to high prices of supplies and wages.

Owing to litigation, the Sixteen-to-Oone and Twenty-One mines are practically closed. Small crews are employed at the El Dorado, Plumbago, and Tightner mines.

Downieville.—The Mexican company is employing more men than any other in this district. Work continues steady at the Bessler, Kirkpatrick, Oro, and Rock Creek mines.

Forest.—A fair number is employed at Bald Mountain, North Fork, and Mugwump. At the last-named a gravel mill is working satisfactorily.

Sierra City.—Forty men are working at the Monarch mine, also a few at the Sierra Buttes and Young America.

COLORADO

Denver.—The 172-page report of the Smelter and Ore Sales Investigation Committee of this State is now being distributed, and those interested are advised to secure a copy, as only 1000 are available. Miners of base-metal ores should be especially concerned with this report. The Committee's work was to investigate all matters connected with the purchase and sale and marketing of metalliferous ores in Colorado. Some interesting charts and schedules are given.

LAKE COUNTY

Leadville.—In new ground the Dold Mining Co. has opened a large deposit of manganese ore. Since January 1 a contract called for 50 tons daily of this ore.

At Climax the Climax Molybdenum Co., a subsidiary of the American Metal Co., has finished its 250-ton mill, also completed arrangements for housing its 185 employees. About 5000 ft. of work has been done in ore, and monthly progress is 1000 ft. According to the manager, J. M. White, ore-reserves are considerable.

OURAY COUNTY

Ouray.—At the Genesee-Vanderbilt and Yankee Girl mines, on Red mountain, the Red Mountain Mines Co. is employing from 50 to 60 men. Snow has suspended shipments from the Genesee. Recent developments are reported as good.

During January the Camp Bird company advanced its adit nearly 600 ft.—a record. At this rate it is expected that the objective point will be reached by May.

TELLER COUNTY

Cripple Creek.—The shoot opened on No. 10 level of the Cresson is officially reported as the most important for some time. Reserves in the mine are estimated to contain $3,327,513 net profit. During December the profit was $61,291. On January 23, cash amounted to $1,133,117, plus 30 cars of ore worth $20,000 net.

IDAHO

BLAINE COUNTY

Hailey.—Seven feet of ore, assaying 5.8% zinc, 9.3% lead, and 4.8 oz. silver, has been opened at a depth of 280 ft. in the Black Barb mine, 12 miles west of this place. J. B. Sawyer is manager.

BONNER COUNTY

Sagle.—In No. 3 adit of the Armstead Mines company the vein is 10 ft. wide, of good grade. This is twice the width of that on No. 2 level, 1000 ft. above on the dip. On February 1 No. 3 adit was in 3543 ft., 451 ft. being driven in January. It is proposed to erect a mill in the spring. H. H. Armstead is president.

CLEARWATER COUNTY

Pierce.—Dredging operations by the Pierce company have been stopped here, and the boat is being re-built five miles upstream.

IDAHO COUNTY

Orogrande.—At the Orogrande Mining Co.'s property a 300-ton mill has been erected to treat from $2.30 to $3.60 gold ore. A profit of $1 per ton is expected, and a recovery of 90%. William Hogan is now in charge.

SHOSHONE COUNTY

Burke.—On No. 5 level of the Hercules, at a depth of 2000 ft., an orebody from 35 to 40 ft. wide has been opened for 480 ft. The lead-silver ore is rich enough for smelting direct. The shoot pitches east. This development is of great importance to this large producer.

The Imperial Mining Co. has spent $67,097 on development, and has driven over a mile of adit and cross-cuts. In the upper workings 48% lead-carbonate ore was opened, and ore was exposed for 400 ft. A winze sunk 55 ft. below the high-grade shoot opened from 18 to 60 in. of 3½ to 5% ore. In the lower workings from the main adit no ore has been found.

Mullan.—According to J. B. Short of the Butte & Coeur d'Alene Mining Co., there is considerable activity in this district, including his own company, Carbonate Hill, Snowstorm, West Hunter, National, Copper King, and Reindeer Queen. The National is now making from $12,000 to $15,000 profit monthly.

Sunset.—On March 22 the Sunshine Mining Co. will decide whether it will join the consolidation of properties on the north slope of the mountain in the Beaver district. It is proposed to increase the capital from $1,500,000 to $2,700,000, and acquire contiguous ground, especially the Toughnut, Tuscumbia, and Idora properties. The Idora Mining Co. has voted to join the consolidation.

MICHIGAN

HOUGHTON COUNTY

Houghton.—On March 20, Calumet & Hecla will distribute $10 per share, the same as paid for the previous quarter.

Copper Range has declared a quarterly dividend of $1.50 per share.

Allouez is producing 1900 tons of ore daily. The five electric locomotives are working satisfactorily.

White Pine Extension employs 50 men. Work is confined to No. 2 and 4 levels.

Tributers in the Winona averaged 15 lb. of copper per ton in December, against 17 lb. in November.

Mechanical tramming is in satisfactory operation on two levels of the Hancock.

MISSOURI

JASPER COUNTY

Joplin.—Production of the Komspelter region during the week ended February 9 was 6210 tons of blende, 245 tons of calamine, and 1473 tons of lead, averaging $55, $33, and $84 per ton, respectively. The total value was $476,922, making

$2,782,082 for six weeks. The Oklahoma field contributed 3738 tons of blende, and 1146 tons of lead. The car shortage was partly relieved, and prices were practically unchanged.

The first drill put down by the Ten Commandments Mining Co., of Asbury, near Joplin, passed through ore from a depth of 212 to 276 ft., estimated to average not under 15% zinc. From 90 to 110 ft. depth the ore assayed from 3 to 5%. A mill is contemplated.

The Ferch Mining Co., operating a lease of the Continental Zinc Co. on West Seventh street, Joplin, has opened good ore to a depth of 224 ft., and is considered to have one of the most promising mines in the district.

MONTANA

Fergus County

Kendall.—On February 15 the Barnes-King Development Co. distributed 10c. per share, equal to $40,000. During January about 11,000 tons of ore yielded over $120,000.

Lincoln County

Troy.—During January the Snowstorm Consolidated treated 6500 tons of ore. Floods early in the month curtailed operations somewhat. Zinc concentrate worth $8000 has been accumulated, and daily additions are up to 30 tons. No. 6 tunnel has reached a depth of 1100 ft. T. L. Greenough is manager.

Mineral County

Iron Mountain.—January shipments from the Intermountain Copper Mining Co. were valued at $15,000 net. The last car of concentrate averaged 18% copper. Mill improvements raised the grade 3%. Ore is mined from the 400-ft. level. The 700-ft. level is under water, but may be re-opened in the spring.

Silver Bow County

Butte.—The Granite Mountain shaft of the North Butte Mining Co. has been concreted from the surface to a depth of 3000 ft., also the surface equipment has been remodeled. The total cost was $300,000. Hoisting will be resumed at once.

In the dispute over certain ore in the Black Rock claim, the United States Circuit Court of Appeals on February 19 affirmed the decision of the District Court of Montana and ordered a decree entered in favor of the Clark-Montana Realty Co. and the Elm Orlu Mining Co. against the Butte & Superior Mining Company.

NEVADA

Clark County

Las Vegas.—The Manganese Association has been incorporated recently, with James McCoy as general manager and F. A. Stevens as secretary. Auto-trucks are hauling 60 tons of manganese daily. A standard-gauge railway is to be constructed. The Seaboard Steel Co. takes all of this ore and hopes to get 200 tons daily.

Elko County

Tuscarora.—This old silver district is again attracting the attention of prominent mining men. The rising price of silver has made possible the operation of many mines here. Last year the assessment roll of Elko county showed that work had been done on 132 claims at Tuscarora. This centre has a past production of $50,000,000 and over $10,000,000 was paid in dividends.

There are three groups of properties under separate ownership at present, and these represent practically the whole district. The first is the Grand Prize, idle at present, consisting of the Phoenix, Early Morning, Golden Treasure, New Housdale, and New Era claims. This group is owned by the Wheeler family, and Z. F. Wheeler of Tuscarora is in charge; the second is the Commonwealth, under option to the Stewart Mining Co. of Idaho, consisting of the Commonwealth, Silver King, Diana, North Belle Isle, Exter, May Queen, and McVystal claims; and the third comprises practically the remainder of the claims in Tuscarora, including the Navajo, Dexter, Young America, Eira, and Ecletic. This group also controls the Tuscarora water-works, which brings water from Taylor canyon and cost over $80,000, and the Jack Creek power-plant. The owners of this group are E. K. Stallo and Samuel Newhouse of Salt Lake City. A syndicate is now being formed to operate this property.



TUSCARORA AND DISTRICT, ELKO COUNTY, NEVADA

The dumps of Tuscarora represent a large sum of money. Nearly all of them can be made to pay by screening out the coarse material and working the fine. Some of the dumps are immense, the Navajo, of the third group, having upward of 300,000 tons, and the Grand Prize over 350,000 tons.

Good veins are known to exist in many of these mines. It must be remembered that it has been a long time since silver was at a price high enough to enable these mines to operate. Milling costs were high years ago, being about $27.50 per ton. In the Grand Prize, at 780 ft. a vein is said to be in places 17 to 18 ft. wide that will assay 22 oz. silver and some gold. In the Dexter and Young America mines good orebodies exist, known to old-timers, and can be worked at a good profit today. Core-drilling is necessary in this district to prove quickly and cheaply what exists.

Esmeralda County

Goldfield.—It is reported that rich ore is being opened in a winze in the Red Hills Florence mine. On February 14 about 100,000 shares changed hands, declining from 7 to 5c. each, due to lack of news.

Humboldt County

Golconda.—An extensive deposit of manganese is said to

have been discovered near Adelaide canyon, 12 miles south of Golconda, by W. S. O'Brien, J. Tucker, and T. Tucker. The ore assays 51% metal, according to analysis made at Winnemucca.

LYON COUNTY

Yerington.—The Bluestone Mining & Smelting Co. is shipping 100 tons of ore daily to the Mason Valley smelter at Thompson. Development is said to have opened enough ore to supply a mill of 800 to 1000 tons daily capacity. A plant including two 8-ft. Hardinge ball-mills and flotation apparatus is to be ready by March.

NYE COUNTY

Manhattan.—Argument in the White Caps-Morning Glory apex suit was completed on February 14, and a decision was expected at an early date.

Tonopah.—The old Liberty mine, 20 miles north of Tonopah, has been re-opened by W. H. Aubrey, and at a depth of 60 ft. there is showing 10 ft. of ore assaying 60 oz. silver and 6½% lead. This mine was opened to a depth of 700 ft. in the seventies.

WASHOE COUNTY

Virginia City.—Two shifts are working at 2000 ft. in the Con. Virginia, where low-grade ore was exposed years ago.

In the Mexican mine, interest centres around exploration at 2300 feet. A 10-cent assessment has been levied.

WHITE PINE COUNTY

Ely.—From the 160-ft. level of the Willow Creek Gold Mining Co.'s property 450 lb. of ore, worth $2500, was shipped to San Francisco by express last week. The lode is 4 ft. wide, containing an 8-in. streak of rich ore.

NEW JERSEY

SUSSEX COUNTY

Franklin.—Results of New Jersey Zinc Co. during 1917 and 1916 are as follows:

	1917	1916
Net income	$19,086,601	$34,488,239
Dividends	12,600,000	26,600,000
Surplus	$6,846,601	$7,888,239

From the 1917 surplus of $6,486,601 there was deducted $4,381,650 as additional Federal taxes for the first and second quarters imposed by Act of October 3, 1917, thereby cutting the surplus to $2,104,952.

NEW MEXICO

SOCORRO COUNTY

Mogollon.—The Socorro is opening the Consolidated and Gunboat mines by adits and is also driving the 700 and 1100-ft. levels of the Fanny mine. The Oaks Co. is starting a shaft in the Clifton adit under a stope from which it has been milling $15 ore. The company is shipping from and developing the Queen vein in the Eberle mine 1500 ft. farther south; the last shipment milled over $11. Mr. Peterson and associates are developing the same vein a mile farther to the south and have found good ore. The Queen vein crops strongly for several miles and varies from 10 to 30 ft. in width. Extensive development work is planned for this vein during the present year.

OKLAHOMA

OTTAWA COUNTY

Picher.—On account of finding a 25-ft. orebody in its ground, the National Lead & Zinc Co. has resumed milling operations north-west of Picher.

Quapaw.—The Big Three Mining Co. has sold 40 acres to Howard Paschal of New York for $75,000, plus 2½% royalty. The present shaft is to be deepened.

The Quapaw Mining Co. is to erect a mill on its 80-acre lease near the Lincolnville station, a mile south of Quapaw. Drilling this ground revealed a deposit 20 ft. thick at a depth of 100 ft. No. 1 shaft has yielded 4000 tons of ore, which is ready for the new plant. A 5% royalty is paid the owners of the land.

Either a 250 or 400-ton mill will be erected by the Medical Mining Co., operating west of Quapaw. Twenty-five drill-holes showed good ore.

Tar River.—The 50-acre lease of L. P. Buchanan of Joplin, Missouri, near Baxter Springs, is developing well. Thirty drill-holes showed 10% ore.

Oklahoma City.—The Crescent Lead & Zinc Co., controlled by local people, will proceed with the erection of a mill on a 40-acre lease in the north-west quarter of the north-east quarter of section 33, and will bring the property to a state of production at the earliest possible date. The land has been prospected, 14 drill-holes having been put down, showing a good deposit of ore, A shaft is now being sunk. The land is near the Welch mines, which were sold last July for a price said to be $2,000,000. The men composing the Crescent company are James Auderbach, Oklahoma City; W. A. Doty, Newkirk; S. Bowman, Durant; W. L. Townsley, Sulphur.

The Bethel Mining Co. is making improvements on 3 leases, the Bethel, the Domado, and the Croesus. Drill rigs are being operated on all the properties. Three are on the Croesus, three on the Domado, and one on the Bethel. Twenty feet of ore has been penetrated on the Bethel and the Domado leases, assaying from 8 to 15%. It is probable that mills will be built on each of the three leases. The Bethel mill has been down for some time and has been entirely overhauled. Among the improvements, 10 tables have been added to the sludge department. The Croesus has been overhauled also and a number of changes made.

TEXAS

BREWSTER COUNTY

Terlingua.—It is thought that if there should be no great drop in the price of quicksilver during the present year the production of this metal in Texas will show a considerable increase, according to the statements of men who are interested in the industry of mining and treating cinnabar ore in the Terlingua district. The production of the metal in this State last year was nearly double in quantity and nearly quadruple in value what it was for the preceding year. The Terlingua district gave a total yield of 10,759 flasks for 1917, compared to 6506 flasks for 1916.

Owing to the fact that the Terlingua district is situated 90 miles from the nearest railroad point, Marfa on the Southern Pacific, and that the district is a dreary inhospitable part of the upper Rio Grande border, there has been little prospecting for cinnabar ore. It is well known that the cinnabar-bearing formation extends across the Rio Grande into Mexico and that it covers a much wider area on the Texas side of the river than has been developed up to this time. The cost of getting in supplies is heavy on account of the remoteness of the camp from the railroad. The cinnabar claims that were located north-east of Boquillas some time ago are to be developed as soon as machinery and furnaces can be installed. The work of opening up the mines situated in Mexico, opposite Terlingua, will begin as soon as border conditions in that country become more settled.

UTAH

JUAB COUNTY

Eureka.—Encouraging reports came from the Zuma mine, where a winze below the 500-ft. level is in good ore. New machinery has been ordered.

Exploration is under way at a depth of 200 ft. in the Republic mine, in charge of E. R. Higgenson. The upper levels produced some good ore some time ago.

During December the Dragon Consolidated shipped 8000

tons of ore, which is desired by smelters for its fluxing qualities. Below the 1000-ft. level a winze is down 600 ft. in new ground.

No. 1 shaft of the Iron Blossom is down 2100 ft., and is to be sunk deeper, according to Frank Birch, the manager. Monthly earnings are $10,000.

Tintic.—During 1917 the Mammoth Mining Co. shipped 40,000 tons of ore worth $1,250,000. Dividends absorbed $400,000. Present weekly ore shipments are about 15 carloads.

SALT LAKE COUNTY

Alta.—At the recent annual meeting of the Michigan-Utah Con. Mines Co. all officers save one were re-elected. R. R. Van Valkenburg is mine superintendent, and R. A. Brown consulting engineer. The financial condition of the company is much improved.

SUMMIT COUNTY

Park City.—Ore shipments from this centre during January totaled 205 carloads, equal to 10,547 tons. The Ontario Silver company contributed 3533 tons; Judge, 2791 tons; Silver King Coalition, 2417 tons; Silver King Con., 936 tons; and Daly West, 633 tons.

WASHINGTON

FERRY COUNTY

Spokane.—The ninth annual convention of the Northwest Mining Association opened on February 12. There was a large attendance from British Columbia, Idaho, Montana, Oregon, and Washington. A large number of minerals was exhibited, also a moving picture depicted 'Spokane to the Bunker Hill & Sullivan.' A variety of subjects was discussed, including mining war-tax, mineral-land laws, production and prices of metals, leasing mineral lands, leasing coal lands, protecting investors in mining stocks, handling explosives, concrete in mine operations, acetylene mine lighting, give miners a square deal, what stimulates mining, mining legislation, value of the Mining Association, oil-flotation, and mine-safety work. Opposition to Government control of mines, unless an actual shortage of minerals develops under private management, was voiced. Government subsidies to encourage production of rare metals, the Federal control of custom smelters and metallurgical processes and patents, with prices fixed by Government agencies, were asked; and free admission of lead and zinc ores between Canada and the United States was petitioned for. Purchase by the Government of a quantity of silver at $1 per ounce was endorsed, and the creation of a Federal department of mining, with a Cabinet member at its head, was asked.

THE U. S. CIVIL SERVICE COMMISSION at Washington, D. C., announces an open competitve examination for assistant coal mining engineer, to fill a vacancy in the Bureau of Mines for service in the field, at $1800 to $2400 per year. The duties of this position will include assisting in the conduct of investigations relating to coal mines, particularly into the causes of mine explosions and other mine accidents, avoidable and unavoidable losses of coal in mining, and the method of remedying such accidents and losses. Applicants must not have reached their 45th birthday on the date of examination. Applications must be filed by March 19.

THE ENGINEERING COUNCIL OF THE UNITED ENGINEERING SOCIETY, New York, states that it has extensive lists and information concerning engineers in this county, and desires to know who have joined any kind of Government service and who are available for positions that may be open in connection with the Army and Navy.

A meeting of the New York section of the MINING AND METALLURGICAL SOCIETY OF AMERICA was held at New York on February 14. The speaker of the evening was Simon Lake, one of the original inventors of the submarine.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

F. L. RANSOME was at New Almaden this week.

G. W. HIND, of Abiline, Texas, is in San Francisco.

E. P. MATHEWSON is expected in San Francisco next week.

C. VEY HOLMAN has been appointed State Assayer in Maine.

J. H. G. WOLF has gone from San Francisco to Washington.

ROBERT F. LETTS, of Lima, Peru, is on a visit to San Francisco.

E. C. HOMERSHAM has returned from Johannesburg to London.

J. A. REID, of Cobalt, Canada, was at Wickenburg, Arizona, last week.

DAVID J. PULLINGER has returned from Nicaragua to San Francisco.

GEORGE C. CARPENTER, president of the National Lead Co., Denver, is here.

HERBERT C. WOOLMER has left Moscow, Russia, and is now resident in London.

M. W. VON BERNEWITZ has resumed his duties as Assistant Editor of this paper.

H. H. NICHOLSON is examining zinc-lead properties in the Joplin district, Missouri.

F. C. FRENCH is now Captain in the Engineer Officers Training Corps at Camp Lee, Virginia.

THOMAS F. SHERIDAN, of counsel for the Butte & Superior Mining Co., is at the St. Francis hotel.

C. H. HAND, formerly of Butte and now living at Los Angeles, was in San Francisco this week.

RENO H. SALES. geologist to the Anaconda Copper Co., has been to the Black Rock district, in Arizona.

W. M. H. WOODWARD has been appointed First Lieutenant in the 513th Engineers, and is stationed at Camp Travis, Texas.

LINDLEY M. GARRISON, of counsel for Minerals Separation, is here with SETH GREGORY, the company's manager at New York.

H. FOSTER BAIN is returning from China to accept the position of assistant to the Director of the U. S. Bureau of Mines.

I. F. LAUCKS, formerly of Falkenburg & Laucks, has opened chemical and metallurgical laboratories at 99 Marion street, Seattle.

W. A. CATTELL, formerly consulting engineer in San Francisco, is now Major and has been assigned to active service at Camp Lee, Virginia.

W. L. PENICK, recently foreman of the experimental mill at Anyox, B. C., has joined the staff of the Hardinge Conical Mill Co. at Salt Lake City.

CHARLES O'CONNELL has resigned as manager of the Tough Oakes mine to become manager of the Boston Hollinger, at Boston Creek, Ontario.

CHARLES L. HARRINGTON has resigned as superintendent for the Overall Mine Co. to become mine superintendent for the Schlesinger Radium Co. of Denver, with headquarters at Naturita, Colorado.

CHARLES EDWARD STUART, formerly member of the engineering staff for the American Smelting & Refining Co., is now Captain in the Engineer Reserve Corps, and has been assigned to duty in the 312th Sapper Regiment of Engineers.

THE OREGON SCHOOL OF MINES SOCIETY held a special meeting on January 28. Thomas Varley, superintendent of the Northwest Experiment Station, U. S. Bureau of Mines at Seattle, addressed the Society. He discussed in some detail the development and work of the Bureau, and gave a brief résumé of the conditions affecting war minerals on the Pacific Coast. About 40 members were present.

Book Reviews

Compressed Air Practice in Mining. By David Penman. Pp. 221. Index, 113 ill. J. B. Lippincott Co., Philadelphia. 1917. For sale by Mining and Scientific Press. Price, $1.75.

The value of this little treatise seems to be mainly for shop use. It gives the fundamentals of the subject of air-compression in simple language, discusses adiabatics, the compression curve, the expansion curve, the construction of the isothermal and the adiabatic diagrams, multiple-stage compression, and expansion, with examples. Efficiency of compressors and air motors is then taken up, and the indicator diagrams follow in a separate chapter, after which comes a discussion of reciprocating air-compressors, the turbo-compressor, and the general principles of transmission of power. There is more in the book, especially with reference to rock-drills and coal-cutting machinery. It is a handy work that will be appreciated by men who wish a simple statement of the problems involved.

Metric Tables. By Guilford L. Molesworth. Spon & Chamberlain, New York, 1917. For sale by Mining and Scientific Press. Price, 75 cents.

This is the fourth edition of a vest-pocket booklet that will be particularly appreciated, now that so strenous an effort is being made to introduce the metric system into this country. Opinions differ as to the advisability of compelling the use of the metric system, but it is certain that the acceptance of that system will widen rapidly in the next few years as a commercial necessity, in order to give us an outlet for our manufactures in other countries, where, to put it frankly, the inch and the foot are so great a nuisance that workmen object to handle anything which calls for repairs on the basis of English measures, for which no gauges are available in their shops. This little book is adapted for ready conversion of all weights and measures, and also has tables giving the relationships between kilogramme calories and British thermal units, and prices in francs and shillings per unit of weight and length. It is a pity that similar tables in terms of American currency were not added.

Electric Furnaces in the Iron and Steel Industry. By W. Rodenhauser, J. Schoenawa, and C. H. Vom Baur. Second edition. Completely re-written. Pp. 429. Index. John Wiley & Sons, New York, 1917. For sale by Mining and Scientific Press. Price, $3.75 net.

This book was published originally in German, in 1911, and brought into English in 1912. The new edition covers the advances made to the date of publication, which is September 1, 1917. It is a book that has made a strong appeal, owing to the widening interest in the production of iron and steel by the electric furnace. The growth of the electric steel industry has been enormous in the United States in the last three years, so that we now manufacture more steel by that process than all the rest of the world together. The book is not a highly technical discussion, but is adapted for the average electrician, and is not complicated by the introduction of the calculus. It gives a historial review of the subject, the laws and fundamental principles of electricity, with special reference to the effects of the electric current in its application to furnace-work, it has an illuminating chapter on the power factor, and the alternating current theory in general. It discusses the principles of arc-furnaces, and then takes up the special types, such as the Stassano, Héroult, Girod, and the Rennerfelt. Chapter IX describes the induction furnace, after which follow accounts of the Kjellin furnace and the Röchling-Rodenhauser furnace, electric shaft-furnaces, and a general review of numerous other types. Part II deals with the practical operations, such as materials for construction, cost of operation, and the technique of the electro-metallurgy of iron and steel. As an introduction to the subject, it is undoubtedly one of the clearest statements at present available.

The Mines Handbook. Edited by Walter Harvey Weed. Vol. XIII. Pp. 1919. Ill., maps, index. The Mines Handbook, 29 Broadway, New York, 1918. For sale by Mining and Scientific Press. Price, $10.

If the founder—Horace J. Stevens—of 'The Copper Handbook' were alive to see what has been evolved from his early efforts he would be astonished at the scope of the thirteenth issue, now known as 'The Mines Handbook.' It is rightly termed an "international edition," for while Skinner's 'Mining Manual' covers most of the British-owned companies, 'The Mines Handbook' describes the most important of these and all in North and South America. The new volume contains notes on mines producing antimony, chrome, copper, gold, iron, lead, magnesite, manganese, molybdenum, nickel, quicksilver, tungsten, and zinc; iron being the important new section added this year.

In most publications of this kind, companies are arranged alphabetically, irrespective of country or metal. Such a scheme is simple enough and requires no index, but conceals imperfections; also it was difficult for engineers and machinery manufacturers to study any particular group of mines. These faults have been remedied by a geographical arrangement and index, the latter being on tinted paper in the front part of the book. The new system is one of countries, states, counties, districts, and towns; and at a glance one is able to determine the success or otherwise of any properties. If the geology is not given for all mines in a district, probably its description will be found under one mine, which might serve the lot. Another new feature, and one that should be extended considerably, is the inclusion of 31 maps of regions and districts. These add greatly to the study of a company's condition. Between each country is a clear break; a neat arrangement.

Reviewing seriatim, we find the index complete and well presented. The glossary of mining terms—21 pages—contains all that the ordinary mining man requires; as also do the four pages on mineralogy. In Chapter III are 19 pages covering all copper-bearing minerals; a useful list. Inquiries are frequently made concerning some company that is either merged, dead, liquidated, dissolved, bankrupt, or the like, such being difficult to trace; but here we find a list of approximately 4500 concerns under this head. Anybody reveling in statistics will have ample to satisfy himself in the 96 pages of Chapter V. Data have been brought right up to the end of 1917 in many cases, while foreign trade in metals covers eight months. The accompanying comments are worth-while. From page 249 to 1864 are described the officers, financial details, property, geology, development, equipment, and production of 4661 of the leading—and small—companies of the world. The text ranges from one line to fourteen pages for each, and is not so dull as one would expect in such a publication, as abstracts are given from leading journals on technical considerations at many mines, which makes the work more useful than ever. Foreign companies are well represented, especially the Japanese. The final 12 pages contain a re-print of the editor's—Walter Harvey Weed—address on 'Copper in America' delivered before the Pan-American Congress at Washington, D. C., in 1916.

'The Mines Handbook' is well printed on thin paper, opens flat, and is properly bound. In spite of all care, typographical errors creep in, and we note incorrect spelling on pages 32, 271, and 1727; a line upside down on page 569, and one out of place on page 1354. These do not detract one bit from the value of this handsome and useful reference work.

THE METAL MARKET



METAL PRICES

San Francisco, February 18

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.90
Antimony, cents per pound	15.50
Antimony (wholesale), cents per pound	13.16
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	25.12
Pig-lead, cents per pound	7.25— 8.25
Platinum, soft and hard metal, respectively, per ounce	$108— 116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	17.50

ORE PRICES

San Francisco, February 18

Antimony, 45% metal, per unit	$1.05
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.85— 1.00
Magnesite, crude, per ton	$8.00—10.00
Manganese: basis 40 to 44% Mn and 8% SiO_2, cents per unit	70.00—80.00
Tungsten, 60% WO_3, per unit	26.00
Molybdenite, per lb., 85% MoS_2	$2.15

February onward, tungsten, molybdenum, vanadium, manganese, chrome, and ferro-alloys come under the license authority of the American Iron and Steel Institute, in so far as these ores are imported from abroad. Importer dealers and consumers are henceforth required to give a guarantee before material is released to them.

New York, February 14

Chrome: High-grade ore is scarce, and practically none can be obtained from California. Market price is anywhere from $1.50 to $1.75 per unit, f.o.b. shipping point, for material carrying over 45% Cr_2O_3.

Manganese: February schedule for domestic ore continues at the same prices as in January. The rainy season having ended in Cuba and Porto Rico, manganese shipments from there have been resumed.

Tungsten: All buyers of high-grade ore seem to have fully covered their requirements for the present, and no business in this class has been done during the week. A fair amount of other grades, however, found a ready market. Stocks in New York, in the Middle West, and in the West, have accumulated on account of freight congestion. On the other hand a cable has been received from Bolivia stating that a flood has caused a washout on the railroads, and this will probably curtail shipments from that country. It is possible that smaller shipments from Bolivia will offset the present accumulation of ore in New York.—Charles Hardy's weekly report.

EASTERN METAL MARKET

(By wire from New York)

February 19.—Copper is quiet; lead is dull and firm; spelter is inactive though steady; platinum is unchanged at $108 to $116.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Feb.	13 — 85.62	Jan.	8 — 88.66
"	14 — 85.62	"	15 — 90.04
"	15 — 85.62	"	22 — 89.29
"	16 — 85.37	"	29 — 87.35
"	17 Sunday	Feb.	5 — 86.62
"	18 — 85.37	"	12 — 85.93
"	19 — 85.37	"	19 — 85.48

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	....	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

Silver exports from San Francisco during January included coin worth $328,545, and bullion valued at $4,020,394, a total of $4,348,939. Destinations were as follows: all of the coin and $3,695,186 bullion to India, and $325,208 bullion to China.

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	....	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Tin: This metal is as firm as ever. During the holidays the market in London advanced considerably, but no Straits tin is offered for sale on the American market. Banca tin is quoted at 74c. for February shipment, and Chinese No. 1 at 65 to 66c., according to position.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Feb.	13 — 23.50	Jan.	8 — 23.50
"	14 — 23.50	"	15 — 23.50
"	15 — 23.50	"	22 — 23.50
"	16 — 23.50	"	29 — 23.50
"	17 Sunday	Feb.	5 — 23.50
"	18 — 23.50	"	12 — 23.50
"	19 — 23.50	"	19 — 23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	....	Aug.	27.03	27.42	....
Mch.	26.65	36.00	....	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Feb.	13 — 8.00	Jan.	8 — 7.87
"	14 — 8.00	"	15 — 7.87
"	15 — 8.00	"	22 — 7.87
"	16 — 8.00	"	29 — 7.87
"	17 Sunday	Feb.	5 — 7.87
"	18 — 8.00	"	12 — 8.00
"	19 — 8.00	"	19 — 8.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	....	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

On February 14, President Wilson approved an agreement reached by the War Industries Board and the producers of grade A zinc, fixing a maximum price of 12c. per pound f.o.b. East St. Louis, subject to revision on June 1. A maximum price of 14c. per pound for plate zinc f.o.b. at plants and 15c. per pound for sheet zinc f.o.b. at plants was fixed subject to the usual trade discount.

The following conditions were laid down: (1) that the producers of grade A plate and sheet zinc will not reduce the present wages; (2) that the Allies, the public, and the Government will be sold zinc at the same prices; (3) that they will take necessary measures to prevent zinc from falling into the hands of speculators who might increase the price to the public; (4) that they exert every effort to keep up the production so as to assure an adequate supply during the War.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Feb.	13 — 7.00	Jan.	8 — 6.65
"	14 — 7.10	"	15 — 6.75
"	15 — 7.10	"	22 — 6.98
"	16 — 7.10	"	29 — 7.00
"	17 Sunday	Feb.	5 — 7.00
"	18 — 7.10	"	12 — 7.00
"	19 — 7.10	"	19 — 7.08

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	....	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending			
Jan.	22 — 125.00	Feb.	5 — 125.00
"	29 — 125.00	"	12 — 125.00
		"	19 — 115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	.....
Feb.	295.00	126.25	.....	Aug.	74.50	115.00	.....
Mch.	219.00	113.75	.....	Sept.	75.00	112.00	.....
Apr.	141.60	114.50	.....	Oct.	78.20	102.00	.....
May	90.00	104.00	.....	Nov.	79.50	102.50	.....
June	74.70	85.50	.....	Dec.	80.00	117.42	.....

Eastern Metal Market

New York, February 13.

An already dull and inactive market in metals has been rendered more uninteresting and featureless by the two holidays this week. Yesterday was Lincoln's birthday, which is always closely observed in New York and Monday was another 'fuelless' day which, it is hoped, is the last one. There was no business in metals done on either of those days, hence the period which this letter covers is really only four days—the last four of last week.

Copper continues to be dominated by Government regulation and orders which are doubtless large, but not made public.

Tin has been quiet again with transactions confined to futures, spot metal being unobtainable.

Lead continues inactive but firm.

Zinc is also lifeless and featureless, but steady.

Antimony is lower with little demand.

The iron and steel market has a more cheerful aspect because of the much milder weather all over the East, which has prevailed for several days. The derangement of the whole machinery of production and shipment was so complete that many days will be necessary for any approach to normal operations, even with no more severe winter weather. Excepting last October and November, each month since April last has shown a decline in iron and steel output, revealing the fact that causes go deeper than the weather. Steel operations in the Central West are generally at 60 to 70% of capacity, with some at less than 50%. The marked reduction in pig-iron output in the last six weeks indicates a possible shortage in the later months of this year.

COPPER

In a market devoid of normal speculation, because of fixed Government prices, there is naturally little to report except market development of interest to the trade in general. But with a Saturday followed by two holidays—fuelless Monday and Lincoln's birthday—the source of information is cut down to absolutely nothing. The mild weather of the last week has been a boon, and has mitigated decidedly the fear of a shortage of raw materials at the Eastern refineries. The entire situation is much better, and the hope is strong that it will continue to improve. There was a rumor that some jobbers had been cutting the official price of 24.67½c., but no confirmation of this is found; it is rather vigorously denied. The price of 23.50c. for carload and larger lots still obtains, and supplies seem ample for all concerned. Production is on a large scale, that of the Anaconda company for January having been 24,984,000 lb., contrasted with 13,000,000 lb. per month last July, August, and September.

TIN

In the four days on which any business was done—Wednesday, Thursday, Friday, and Saturday—the market was quiet. On those days a little business was transacted in far futures; the total probably aggregated 400 tons. More business would have been done if there had been more sellers. One reason for a lack of sellers is the fact that some or many merchants have gone out of the tin business because of the difficulties and extreme uncertainties. It is stated that if they make a purchase at what appears will net them a fair profit, by the time they obtain the tin the profit has developed into a loss, because of commandeering, demurrages, or other reasons. There has been no further Government commandeering since that reported last week. Transportation difficulties, while eliminated to some extent by the milder weather, continue to interfere with the shipments of metal after it reaches New York, or in the journey overland. Arrivals to February 8, inclusive, total 250 tons, with the quantity afloat estimated at 5275 tons. The last cable from London, on the 8th, reported the spot Straits tin market at £308 per ton, an advance of £7 over that of the 5th, reported in this letter a week ago.

LEAD

The same situation prevails in the lead market that has been characteristic for some weeks—extreme quietness. There was a little better inquiry in the four market days which this report covers, but this statement is entirely relative. The inquiry was not brisk, but the market before this has been stagnant and dead. This better inquiry resulted in some transactions, mostly for nearby delivery, but the tonnage involved was not large. Today (Wednesday) the American Smelting & Refining Co. advanced its price ¼c. per lb., to 7c., New York; but no reasons for this step are yet obtainable. The outside market has been 7c., New York, or 6.85c., St. Louis, up to the present; but a higher level is probable soon, as in the past.

ZINC

The same lethargy that has hung over the market so long continues. Demand is generally light. The Government is quietly taking substantial quantities of zinc, particularly grades A, B, and C (prime Western); but these negotiations are not public. No decision has been announced as to a fixed price for grade A, and all business being done is to be settled for on a price to be agreed upon later. This question of a price for grade A has been up for over eight months, and there is some dissatisfaction because no settlement has been reached. On account of railroad congestion and delayed shipments of materials the market is perhaps a little stiffer, and the quotation for prime Western for early delivery is 7.75c., St. Louis, or 8c., New York, though these can be shaded possibly to 7.62½c., St. Louis, or 7.87½c., New York. Sheet zinc is $19 per 100 lb. base.

ANTIMONY

The market is a little lower at 13.75 to 14c. per lb., duty paid, New York, for Chinese and Japanese grades for prompt or early delivery. Demand continues light.

ALUMINUM

No. 1 virgin metal, 98 to 99% pure, is quoted at 36 to 38c. per lb., New York, for prompt and early delivery, but there is no life to the market.

ORES

Tungsten: Railroad congestion has interfered with business considerably and until more essential materials are moved, now that better conditions prevail, the market will remain inactive. Prices are unchanged at $26 per unit for scheelite, down to $20 for poorer grades. Californian producers are reported to be asking $30 for scheelite. Ferro-tungsten is unchanged at $2.35 per lb. of contained tungsten.

Molybdenum: An active business is reported at $2.15 per lb. of MoS_2 in 85% molybdenite, and some shipments are made by express to get around freight congestion.

Antimony: In this ore there is nothing to report.

Manganese: Quotations are unchanged at $1.25 per unit, delivered at furnace for 48% material and better. According to newspaper report, Brazil has stopped exportation of ore for the time being, and, if this continues, a further rise in price for domestic manganese should be looked for.

Magnesite: Calcined magnesite is offered freely at prices ranging around $35 per short ton, f.o.b. shipping point.



INFORMATION FURNISHED BY MANUFACTURERS

BARBER-GREENE SELF-FEEDING BUCKET LOADER

The distinguishing feature of the B-G self-feeding bucket loader is the rotating double-disc feeder (patents pending) at the base of the elevator. The feeder does the work of two or three men and gives the machine a range that is otherwise impossible. It enables the machine to dig to a width of five feet rather than to the bucket width, and the operator consequently has little difficulty in keeping the loader continuously up to the capacity. The digging or feeding device consists of a pair of horizontal discs, set almost flat on the ground, but



BARBER-GREENE LOADER

with a slight pitch toward the pile. The rotation of the two discs carries the material to the centre where it is picked up by the buckets digging from the smooth surface of the discs. The wide digging-face of this loader enables it to handle a large quantity of material with very little movement, and it also enables the machine to advance without obstruction into the pile. The construction of the machine enables it to use the disc-feeder to the best advantage. The discs deliver a large capacity to the bucket elevator and this, in turn, is of a size consistent with this capacity. It is designed for handling heavy materials and for severe service. The frame construction and the wheels embody strength; the chains and buckets are selected for wearing-qualities; and the drive is designed to enable the operator to keep the machine at productive work for the maximum amount of time. A direct-gear drive to the rear wheels propels the loader forward or the reverse, two speeds in either direction. A differential provides for turning sharp corners. A slow reverse-feeding speed is provided and a high speed forward for road traveling. Two intermediate speeds forward and the reverse enable the loader to be readily spotted on the job. It will handle crushed ore, stone, gravel, clay, coal, cement-clinker, and other materials.

INSULUMINUM

One of the interesting new things which the research laboratories of the General Electric Co. at Schenectady has developed in the past few years is a process for impregnating iron and steel, with an aluminum alloy. The resulting material is a rich ferro-aluminum, of great hardness, and possessing heat-resisting qualities much in excess of iron and steel. It is a discovery of the first importance. Since the close of the bronze-age iron has been used for ovens, utensils, and tools of every kind for all temperatures up to a dull red; but for higher temperatures there has been, even up to the present day, no cheap metal available. Manufacturers and users of a wide range of equipment called upon to meet unusual thermal conditions have been quick to seize the opportunity of increasing the effectiveness and durability of their units by the use of material treated by this new process. It was with a great deal of satisfaction, therefore, that the Diamond Power Specialty Co. was able to announce, a year ago, that in line with its established policy of developing and producing equipment only of the highest order, it had secured the sole right as lessee, from the General Electric Co., to the use of this process in the manufacture of soot-blowers. It seems proper to add at this point that no advantage has been or will be taken of the fact that the exclusive right to this process gives the company a virtual monopoly, so far at least as successful operation is concerned, of certain classes of installations, and that units of Insuluminum (the registered trade-name of the new material) are supplied at merely a nominal advance over the extra heavy steel required in ordinary locations.

The originator of the new method, having in mind the heat-resisting qualities of the product, called the treatment 'calorizing.' The essential point of difference between the effects of this process and any hitherto used commercially, such as galvanizing or sheradizing, is that the insulating material is not imposed as a coating or skin (which may be chipped off) upon the surface of the metal to be treated, but, on the contrary, enters into intimate association with it, so that the whole outer zone of the body affected changes its composition. A

homogeneous alloy is formed, which cannot be destroyed except as the mass of which it is a part is destroyed. The richness of the alloy is proportional to the depth of impregnation, which varies with the length of time of the treatment.

A photo-micrograph of the cross-section of a calorized-steel tube shows clearly the diffusion of the aluminum into the steel resulting from a fairly prolonged treatment. On the outer and inner surfaces of the tube a thin film of alumina is formed, and the thickness of the metal is increased by this slight amount. Under this a wide band of ferro-aluminum is found. In the centre the steel remains unchanged. It is interesting to note the even depth of the penetration.

One of the first questions arising in connection with the adoption of Insuluminum to the Diamond soot-blower system with its ability to withstand the stresses of hard service. The mechanical properties of the new material had to be determined accurately. On this point the General Electric Co. stated: "The coating produced by calorizing is so hard that considerable effort is required to break through it with a file. Consequently, such scratches or scrapings as it receives in normal handling need not be feared at all."

To supplement this information the Diamond Power Specialty Co. conducted a long series of severe tests of Insuluminum tubes, subjecting the metal to bending, flattening, and hammering. The results proved the homogenity of the mass, and its ability to withstand severe treatment without failure. While these experiments were under way, the National Tube Co. became interested in the new metal, and early in the present year subjected it to a series of tests. Their signed statement is as follows: "Our laboratory reports that the calorized coating on 2-in. boiler tubes which they tested, did not fail when these samples were subjected to the standard boiler-tube flanging, crushing, flattening, expanding, and ring-tests."

The conclusions to be drawn from these investigations are self-evident. Insuluminum units are guaranteed to be of homogeneous structure, capable of withstanding the severest conditions to which they may be subjected by the conditions of installation and operation. They will resist for an indefinite time the continued action of temperatures as high as 1000° C. or 1800° F. This is an exact statement of the heat-resisting quality of the new metal. Its importance is apparent from the fact that steel begins to burn, it is believed, at about 370° C. and nickel at 650° C. Both of these metals will bear considerably higher temperatures, of course, but the oxidation of iron and steel becomes pronounced at 500° C., and increases rapidly from this point on.

Every material has an oxidation point, and that of Insuluminum is around 1100° C. If the alumina-film is broken, scaling will set in at a temperature above 1050° C., but if the film is unbroken the scaling temperature will be higher. The high heat-resisting quality of calorized metal makes it much less subject to warping than cast-iron or steel. In only one instance has any serious trouble of this nature developed in a soot-blower system. In the case in question the purchaser insisted upon making the installation himself. He did not make it properly, failing to utilize all the supports provided, with the result that after exposure to high temperature one of the units warped. On the customer's complaint the company made an investigation, and decided to replace the warped unit with a new one properly installed. This was done and no further trouble resulted. The new unit is now in place and reported to be standing up satisfactorily.

The superiority of this new metal over iron and steel for unusual heat conditions has commended itself to a large number of well-known companies. The Dayton Company, Buffalo, N. Y., writes: "Calorizing certainly prevents oxidation, increases heat conductivity, and increases melting points. We find it very essential in the treatment of our gas-making retorts which are subjected to an oxidizing atmosphere at 1600 to 2000° F." The Westinghouse Lamp Co., Bloomfield, N. Y., says: "These calorized tubes are used in furnaces where the temperature is in the neighborhood of 900 to 1000° C. At this temperature, we get normally double to triple the life which we would obtain from ordinary wrought-iron tubes." The Denver Rock Drill Mfg. Co., Denver, Colo., writes: "By submitting the pipe (calorized pipe used as containers in their steel-carbonizing process) to temperatures of 1650 to 1700° F., together with wrought iron, which we ordinarily use, of the same shape, size, and thickness, the calorized material lasted very nearly ten times as long as the plain pipe."

As the dominant factor in the mechanical soot-blower field, it was natural that the Diamond Power Specialty Co. should be the first to develop a means of insulating units so that they might be exposed continuously to combustion gases at high temperature. The original means employed consisted of placing two extra heavy steel pipes, one within the other, the space between being filled with a non-conducting material. The unit proved successful for water-tube boilers, because being capable of withstanding high temperatures it could be placed at points of advantage in the passes where units of other systems would have been destroyed in a short time by the hot gases. As the result of the introduction of this system a thoroughly effective cleaning of the boiler was secured, and a host of friends was made for the Diamond blower. Soon after the calorization process was announced the company's engineers instituted an investigation, lasting many months, of the new material. In addition to the mechanical and thermal tests, trial installations were made in all the different types of water-tube boilers. The Insuluminum units were placed at points in the passes where the temperature ranged from 1800 to 2000° F. The need of blowers at these locations had long been recognized, but their application had been considered impracticable. Performances of the units were watched with keen interest for months, and there was no sign of scaling or disintegration from the long exposures to combustion gases at the high temperatures existing.

Diamond mechanical soot-blowers are the one known positive means of keeping the fire-surfaces of boilers and economizers clean. Their pre-eminence has been recognized by the United States government, the U. S. Steel Corporation, the Ford Motor Co., the Hudson Motor Car Co., Inland Steel Co., Standard Oil Co., and many more. Over 40,000 installations have been made in all parts of the world. At present, boilers in excess of a total of 500,000 hp. are equipped each year with these blowers.

OPPORTUNITY OF THE SMALL QUARRY

One period in the development of man is called the Stone Age, when pieces of rock were used to make cumbersome, but rather effective, mauls for cracking heads; later peoples used larger amounts of stone in various forms to build houses, temples, and tombs, and adopted somewhat more convenient methods of exterminating the unfriendly; today the use of stone is much more extensive, and single American quarries have been crushing and marketing annually heaps of stone that would shame in size the most stupendous pyramid or sacred temple of the ancients.

Crushed stone in one form or another is an important part of practically every class of edifice and public improvement. It is required in the construction and repair of streets, roads, railroads, wharves, factories, and buildings. The art of quarrying and preparing the stone has been highly developed, and millions of tons of crushed stone are hauled annually by the railroads to meet the large and increasing demand.

Practically all open-top cars suitable for hauling stone are now requisitioned for hauling coal and other bulky materials to supply the Army and Navy and the industries contributing to their immediate support and development. This will prob-

ably interfere with the shipment of stone for various purposes for some time, and many contractors have already suspended operations on road building and repair, bridge approaches and other work that should be pushed to rapid completion, because of the limited amount of broken stone available. Many of these contractors have in the past depended on stone shipped considerable distances. In the immediate neighborhood of the work, large amounts of suitable stone are frequently to be found, and the possibilities of opening small quarries, or of utilizing masses of boulders, are left undeveloped. In some cases this stone is as good, or better than the stone specified for the job. The reason for this neglect has been the greater economy and convenience in handling stone from the larger crushing-plants. At this time of limited shipping facilities, small portable crushers can be used in the working of the available stone to the best advantage, where the distances are so small that teams and trucks can be used in delivering the stone so that the jobs can be completed and others begun without delay. When small local quarries are near at hand they can in many instances be depended on for immediate delivery of small orders, and can be rapidly enlarged to meet the full requirements of the job. In other cases it will be necessary to develop entirely new faces, but, if the work is undertaken in time, they can be made to yield a sufficiency of stone with a minimum of delay and overhead cost. There is more need for improving our roads than ever before. In time of war road maintenance is an essential part of our system of national defense which must not be deferred. In the light of the priority rulings the supply of crushed stone for road-building is distinctly something to be undertaken by the small local quarry.

BOILER-ROOM MANUAL

'Finding and Stopping Waste in Modern Boiler Rooms' is the title of a practical treatise intended to serve as a reference manual to aid owner, manager, and boiler-room operator in securing and maintaining economy in the steam plant, which has been issued by the HARRISON SAFETY BOILER WORKS of Philadelphia. It is an exceedingly interesting and valuable book of 274 pages, with index and illustrations, and is not confined to the discussion of equipment manufactured by the company. The several chapters deal with Fuels, Combustion, Heat Absorption, Boiler Efficiency, Boiler Testing, and Boiler-Plant Proportioning and Management, with an appendix dealing with the Cochrane Meters. As an example of the scope of the discussion under these chapter-divisions, that on Heat Absorption covers heat transmission, conduction, convection, radiation, heat-transfer from fluid in a channel, economizers, air-heaters and superheaters, improving absorption, heating-surface and boiler-capacity, boiler settings, refractories and firebrick, soot, scale, softening feed-water, and feed-water heating. The method of treatment is seen from the following excerpt on the subject of feed-water heating:

Heating boiler-feed water by means of exhaust steam effects a saving of about 1% of fuel for each 11° F. rise in the temperature of the feed water.

Besides the fuel saving, heating the feed-water increases the actual steaming capacity of the boilers. The part of the heat required to turn the water into steam supplied before the water enters the boiler diminishes the work of the heating-surfaces, or if, on the other hand, the transmission of heat remains the same as before, more steam will be generated from the same heating-surface, and for the same amount of fuel and hot gases, where the feed-water is preheated. The increase in capacity is in nearly the same proportion as the fuel saving. About one-seventh of the fuel is saved by heating the water from 50° to 210° F., and the steaming capacity is increased by one-sixth.

The saving from an open heater is greater than from a closed heater, since the heat in the condensate from the exhaust steam is wasted by a closed heater, while the open heater saves it. The closed heater also wastes the condensed steam itself, because in the absence of an oil separator it is not suitable as boiler feed, while the open heater makes use of this distilled water as boiler feed. To make 7 lb. of hot boiler-feed the closed heater requires 7 lb. of cold water and 1¼ lb. of exhaust steam, whereas the open heater requires only 6 lb. of cold water and 1 lb. of exhaust steam, assuming that the water is heated from 50° to 210° F. in both cases. This is an important consideration, especially in condensing plants, where the supply of exhaust steam from auxiliaries may be limited. At a matter of fact, however, while open heaters, in which the steam comes into actual immediate contact with the water, will raise the temperature of the water to within 1° or 2° of the exhaust steam temperature, closed heaters with ⅓ sq. ft. per horse-power, the maximum amount of heating-surface ordinarily installed, will not come nearer than to within 15° to 30° of the steam temperature, even when the surface is clean and the heater free from air binding. Accumulations of scale on one side of the surface and grease on the other cut down the heat transmission, while unless the heater has a large surplus of exhaust steam passing through it, air accumulates, blanketing and rendering inactive a part of the surface. The closed heater also does not provide for the elimination of the air and other gases driven off from the water by heat, as does the open heater. Recent researches have shown that the air in solution is the principal cause of corrosion in boilers and piping.

An open heater can be used as a catch-all for all available supplies of exhaust steam and hot water, such as drips and condensate, suitable for boiler feeding. If the amount of exhaust steam from auxiliaries is not sufficient to raise the feed-water to the desired temperature, steam can advantageously be bled from an intermediate stage of the main turbine, such steam working with much higher efficiency than that which goes through to the condenser. If, on the other hand, there is not sufficient boiler-feed water at certain times, as during periods of light load, to absorb all of the auxiliary exhaust, the surplus not required for feed heating can automatically be passed by a flow valve to an intermediate stage of the main turbine and utilized therein.

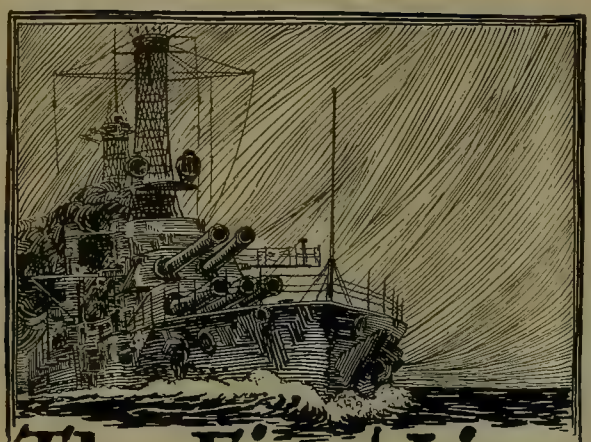
The subject of feed-water heating is fully treated in 'Cochrane Heaters for Steam Power Plants,' published by the Harrison Safety Boiler Works.

The Boiler-Room Manual can be had from the same company. It is listed at $1.

COMMERCIAL PARAGRAPHS

A 391-mile run without mechanical trouble, and delivery of freight several days ahead of railroad schedules, was the recent performance of a 4-wheel drive truck of the DUPLEX TRUCK CO. of Lansing, Michigan. Gasoline used was 59 gal., equal to 6¾ miles per gallon. Although the cost was $56.11, against $41.30 by rail, there was no cartage to pay at each end and delivery was quick.

Chain-driven motor-trucks and tractors are discussed in Bulletin 359 of the LINK-BELT CO. of Chicago. The firm states that it has been making chains for 43 years, and the 'T T' roller-chain is one of its products. Advantages claimed for chain-driven over gear-driven trucks are (1) higher mechanical efficiency; (2) less unsprung weight; (3) semi-elastic driving to protect the machine; (4) the chain receives the most wear; and (5) variable wheel-centres are possible. On the other hand the Link-Belt Co. concedes to the gear types the advantage of enclosed and automatically lubricated driving parts. The publication shows the solid roller, new curled roller, and offset link-plate.



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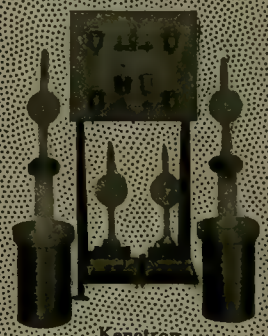
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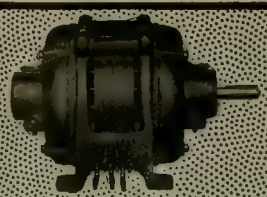
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EDITORIAL

HEARST'S camouflage campaign, ostensibly to raise funds for the re-building of French towns, is being rated at its worth, judging from the subscription list in his local journal of misinformation. To any lover of France the suggestion coming from Hearst is much like the driver of a garbage wagon advocating the re-building of a cathedral.

AT the annual meeting of the Institute at New York the amendment on membership requirements was passed by a vote of 1123 to 59. The election of officers gives Mr. Sidney J. Jennings as president, Messrs. Henry S. Drinker and Robert M. Raymond as vice-presidents, the new directors being Messrs. F. G. Cottrell, Hennen Jennings, George C. Stone, S. A. Taylor, and Arthur Thacher. We feel sure that the profession will take pleasure in recognizing the excellence of the selection made. Apparently that distinguished engineer and technical authority, Dr. Drinker, the president of Lehigh University, is to be the next president.

EXCHANGE with Argentina has been stabilized so that in our trade with that country the American dollar will have a value of 97 cents. The discount is equivalent to the cost of transferring bullion to the southern republic. The Banco de la Nación at Buenos Aires maintains a deposit of $17,000,000 in New York against which commercial credits may be issued, and these transactions will be handled by the Federal Reserve Bank on the basis of par plus 3% commission. Under an arrangement between the United States Treasury Department and the Argentine bank a limit of $40,000,000 has been fixed temporarily as a basis for stabilizing the exchange between the two countries.

JOHANNESBURG has been treated to an exposure of gold-stealing that has opened the eyes of mine-managers on the Rand to the loss caused by illicit dealings in gold by Indians, more particularly. One dealer appears to have sent $580,000 to India in four months, and his books showed receipts for $1,500,000 in a single month. The Transvaal law is stringent on illicit buying of gold and provides severe penalties for infraction, yet it appears that legal proof that the Indian offended criminally is difficult to obtain. We expect, however, that means will be quickly devised for checking theft, for the Boers and the British alike do not regard larceny as in any way humorous or excusable, as has been done at Cripple Creek, for example.

IN our issue of February 2 we expressed agreeable surprise at the optimism of the British directors of the copper companies operating in Siberia in face of the news concerning the condition of general anarchy then menacing Russian industry even in the outlying portions of what was an empire and is now a region without orderly government. We note that news has been received in London through the British Foreign Office that the Bolsheviki have confiscated the property of the Kyshtim Corporation and declared it 'national' property, because the local management "refused to accept the control of the workmen's committees." A formal protest has been lodged through the British embassy at Petrograd.

PAPER shortage is said to have "hit the Congressional Record." We hope the shortage of print-paper may cause Congress to diminish the quantity of useless printed matter that is posted wastefully from Washington. A record of congressional proceedings is necessary, of course, but it should be a true record, not a scrap-book of speeches and statements that were never made, fortunately for all concerned. The amount of waste in the Government Printing Office is deplorable, and it sets a bad example to the State legislatures. For example, we receive circulars and pamphlets from the agricultural departments both of the Federal and State governments, only to be troubled to throw them unopened into the waste-paper basket. Much of it is designed to give cheap notoriety to subordinates and in the attempt to create the impression that a great deal of work is being done, so as to obtain appropriations for the department.

DOLCOATH is a mine in which Cornishmen all over the world take almost a filial concern, so that it will interest them to learn that the two companies controlling the Dolcoath and East Pool mines, at Camborne, have joined in purchasing the mineral rights of the Tehidy Estate, which is the landlord to whom royalties averaging $42,790 per annum have been paid by Dolcoath since

1895. Of the area over which mineral rights extend 2161 acres are under grant to mining companies that have paid an average of $89,175 per annum during the last seven years. The transaction involves 9000 acres, and the freehold of all damaged lands, for the sum of $450,000. The two companies will divide the mineral rights to the land outside their present holdings and thus will obtain both scope and inducement for further exploratory work. It is considered, by those best informed, that this negotiation will prove to be one of the most important events in the recent record of Cornish mining. It removes an incubus that has weighed heavily on progressive development. To Messrs. C. A. Moreing and Oliver Wethered is due the credit for the deal, and we hope that both of them may have the satisfaction of seeing their sagacity crowned by a new era of profitable mining in this historic portion of the old county.

TAXATION of mines was the subject of a paper read by Mr. Henry Louis, Professor of Mining in Durham University, at a recent meeting of the Institution in London. He insisted that the methods of taxation were accountable, in large part, for the decadence of British mining, and then proceeded to lay emphasis on the folly of levying an income-tax on such a wasting asset as a mine. In normal times the income-tax does not weigh heavily on mining companies, but now that it takes 25% of the profit it is a depressing incubus. The inadequate allowance permitted for depreciation of machinery is another unfavorable factor. The subject is of more than provincial interest, for it concerns the multitudinous forms of mining enterprise having headquarters in London and operating mines in different parts of the world. Excessive taxation, some of it illogical, will render inadvisable the registration of companies in England and will thereby rob London of some of its predominant position as a centre of mining finance. The problem is to cause the mining industry to contribute its proper share of the money needed for the War without imposing burdens that will check the development of mines.

GERMANY'S heroic victories over the Russian rabble brings into strong relief the helplessness of the mob that undertook to stop the Prussian by much talking. Those that will not fight for freedom do not deserve to be free. "The good German sword is again at work," as Count von Westarp says, and the point of that bloody weapon has been thrust through the agreements of the Brest-Litovsk conference with a rip and a rent that have been heard from the Baltic to the Euxine. The anarchists that have volunteered to lead the Russian revolution are as helpless as puling babes before the German invasion because they themselves destroyed the discipline of the Russian army before they demobilized it. They can now no more re-mobilize it than they can restore the morale that they shattered by their subserviency to the German propaganda. They continue to make faces at the 'bourgeoisie,' meaning the professional classes and all those sufficiently intelligent not to approve of jumping from the frying-pan of an imperial bureaucracy into the fire of an anti-social chaos. The Prussian and the Bolshevik typify respectively the Scylla and Charybdis between which democracy must steer. Highly organized tyranny and wholly unorganized tumult represent the extremes from which civilization has ever sought to escape. What a fate to be a Pole, a Lithuanian, or an Esthonian today!

IN our last issue we referred to the lack of co-ordination in the duplicated enquiries made by the Geological Survey and the Navy Department into the conditions governing the quicksilver industry of California. We forgot to mention that just before these two investigations were started, a third had been made for the Bureau of Mines by Mr Hennen Jennings. Again we suggest that time and energy be saved by the use of the telephone at Washington. This suggestion would appear to apply even to those in higher offices, for during the past week, we have been treated to newspaper announcement by the heads of the Food and Railroad administrations, followed by the publication of a correspondence that exhibited a curious lack of co-operation. The telephone, or a quiet interview, is preferable to the columns of a daily newspaper as a means of communication between the administrators of national affairs.

The Shift-Boss

Shift-bosses are useful and important men in the economy of a mine. We take pleasure in publishing the text of a short address on the duties of a shift-boss as delivered at Bisbee by Mr. Joseph P. Hodgson consulting engineer of the mining department of the Phelps-Dodge Corporation. The shift-boss is the boatswain of those that go down to the mine in skips. He is the non-commissioned officer upon whom so largely depends the morale of the crew. He is the link between the company and its employees. A mine cannot be well managed without the aid of one or more good shift-bosses. Poor ones will render futile the best efforts of a clever superintendent. The shift-boss selects the men for different tasks; he tells them what to do, and is able to show them how to do it. Being in close touch with the men, he is the first to know if trouble is brewing, if they are dissatisfied, or if they are unfairly treated—and he himself may be the immediate cause of trouble by treating individuals unfairly, showing favoritism, or exhibiting bad temper. Again, the shift-boss is expected to have a keen eye for ore, to see that the working-places are safe, and to report any significant changes in the face of a level or stope. He sees to the safety of the working-places, and is the first to give aid when accidents happen. To the young mining engineer the shift-boss looms large. In him the technical graduate finds a storehouse of valuable experience, and from him can be obtained the practical hints that no professor or book can furnish. The young man on the way to becoming a mining engineer is wise if he make friends with the shift-boss, for in him he will

find the guide and philosopher of the world underground. To the visiting engineer, inspecting or appraising a mine, it is essential to establish pleasant relations with the shift-boss, for from him can be obtained information of a most illuminating kind. A hint from a shift-boss may be worth as much as a thousand samples. Shift-bosses deserve cigars. Ignorant and loutish shift-bosses there are, of course, but they are rare, because men of such characteristics rarely hold the confidence of the management or the respect of the men. Not only has the standard of shift-bossing improved as mining has become more technical in method and more comprehensive in scale, but a start has been made in training technical graduates for this work of supervision, which affords a splendid training for educated young men possessed of the physique and experience that are essential for such a responsibility. The innovation may succeed, but we shall continue to think of the shift-bosses whom we have known, not technical graduates, but boss miners, quick-witted and strong-armed, keenly observant, good natured, and intensely proud of their mine.

Mexican Finance

When General Porfirio Diaz brought Mexico to order in 1877 he found a country that had plunged blindly through 55 years of virtual medievalism, after its liberation from the colonial exploitation by Spain, without ever having enjoyed opportunity for industrial development. Co-operative effort in manufacturing and commerce had no place in the national life; the people were individualists from necessity, with the good, and not a few of the bad, qualities that germinate in such a society. It requires generations of organized industry to change the spirit of such a people; their understanding of the possibilities of living by personal wit, bravado, and strength is larger and deeper than their faith in the artificial system of a highly developed state. Collective effort and dependence upon the machinery of banks and credits and distribution of commodities, regulated through commercial exchanges, can but slowly replace the more primitive ideas of self-reliance. Those who lived in Mexico twenty years ago will recall the struggles of the banks of issue to establish their currency in the confidence of the merchants. The working people, the petty traders, the forwarding agents that dealt with the freighters who distributed goods throughout the back-country for the most part declined to be paid in bank-bills. Hard money, the safe kind that would not burn, that would neither mildew nor fall to pieces when buried, was the only acceptable currency. The people retained vivid memories of the sudden descent of robber chieftains, of the sort that would have been called counts and barons six centuries ago, when cash must as suddenly be hidden. It was against these medieval suspicions of government that Diaz had to work, and he overcame them so effectually that the currency of nearly all the State banks circulated freely at par throughout the Republic. It was a great achievement. The revolution, however, has whirled the people back into the epoch of self-reliance, of intense individualism, of distrust in government and refined schemes of economic organization. The good work of Diaz has been undone, and it happened before the habits of social co-operation had been firmly established. Most of the men of big business have become exiles; those remaining belong preponderantly to the uneducated classes, who are the most suspicious of all forms and systems, and confidence in the reliability of governmental promises has been shattered by the experiences of the last seven years. Carranza is laboring against greater obstacles than those that confronted the man who gave Mexico her first uplift. At least Diaz did not have to explain any failure of previous experiments to introduce the machinery of civilization. The country has returned to a hard-money basis, and the credit system has been largely eliminated. The effort to create a central bank of issue has been resisted by the Mexican congress. Gold and silver sufficient to guarantee a large issue is not available, and the plans of the administration are not such as to inspire confidence. The result of authorizing such a bank without ample gold reserves would be further complication of the difficult finances of the country. The public would distrust the bank-notes, and as these would be legal tender the first effect would be to cause the disappearance from circulation of the coin now serving the needs of business. A staff correspondent of the New York 'Sun' recently stated that "with an empty treasury, and no credit, Carranza cannot meet the expenses of the Government, and looting as a means of maintenance is scarcely less necessary to his generals than to Villa or Zapata." It is evident that foreign aid is essential for the reconstruction of Mexico. With funds available to meet the obligations of the Government, and with credit and commerce re-established, deliverance is possible. The opportunity lies open through a cordial understanding with the United States; but, for this, a change of attitude on the part of Carranza is requisite. While he is still under the influence of Germany to such an extent that he can telegraph birthday congratulations to the Kaiser "who celebrates his anniversary today with just cause for rejoicing," and more adulation of that kind, the case seems hopeless. The Kaiser left no doubt as to his interpretation of the message from the old cacique when he replied that he was grateful for Carranza's "very amiable telegram of felicitation on the occasion of my birthday." On the heels of this comes word of a new treaty under which Mexico would enjoy the privilege of importing foodstuffs and gold from this country, but the dispatches fail to mention reciprocal advantages that shall accrue to the United States, except the right to draw ores and metals from Mexico, which right has been enjoyed continuously since Carranza came into power. The omission to suggest adequate reciprocity is peculiar. Usually it turns out that we have been too good-natured, just as in the case of Japan, where our arrangement for the exchange of ship-plates for shipping failed to justify the

hopes of our Department of State. It is this easy inefficiency in diplomacy, and our tendency to effusive generosity as the big brother that have so often brought upon us the contempt of the Mexicans, who explain such tactics as an evidence of timidity on our part to deal firmly with their Government. It certainly would be an error to offer Mexico the gold that she so greatly needs unless it were to cement a union equivalent to an alliance. Such a step, even in a country where executive decrees are sanctioned by act of Congress, would be most unlikely without special legislative authorization, and no steps of that kind have been taken. Without an alliance the privilege conceded solemnly by a treaty would be tantamount to strengthening the Enemy and playing into the hands of the Kaiser. News from Mexico indicates that Carranza's authority is lessening; his own generals are not faithful to him; new revolutionaries are constantly entering the field; Pelaez, the friend of the Allies, who has protected the interests of the Americans and British in the Tampico oilfields against the Carrancistas, now has pronounced for the triumph of the constitutionalist cause in Mexico, and has sounded the call for a national revolution. Meanwhile the grafters are making a display of luxury and extravagance in the capital city such as was never seen before, and against it the wretchedness of the poor stands in more pitiable contrast. These are symptoms of a political condition that cannot long endure. We do not wish to see more revolutions in Mexico, and we would welcome an alliance that would ensure the cordial co-operation of the two countries, but while Carranza remains an unregenerate German sympathizer, while he tries to get underneath the agreements of this country and our Allies with Argentina for wheat, and while he showers his favors upon German corporations and follows the lead of German advisors in his financial schemes, and assumes a continuously antagonistic attitude toward America and her Allies, we are opposed to further bolstering of his regime. Friendly acts alone could justify such favors.

Rhodesian Mining

Recent unexpectedly favorable underground developments, including the discovery of rich ore, in several of the Rhodesian gold mines, notably the Gaika, Lonely, and Shamva, have stirred the London mining market to a pitch of enthusiam that must be peculiarly refreshing during this period of financial depression caused by the War. The good news has moved our excellent little contemporary 'The Mining News' to comment on the causes assignable for the "relative failure of the Rhodesian mining industry," meaning the series of disappointments during the last five years that have caused the public to withdraw speculative support from the various surviving gold-mining ventures. Our contemporary imputes the "relative failure" to the lack of working capital and to "the desire of many promoters originally connected with the country to get rich quickly through the medium of the share-market." This is said evidently with a proper regard for the amenities of polite journalism and a discreet recognition of the propinquities of Throgmorton avenue. The real cause is the loss of public confidence in the financial companies that promoted and controlled the various mining enterprises of Rhodesia, more particularly the Consolidated Gold Fields of South Africa, the Amalgamated Properties of Rhodesia, the Rhodesian Exploration & Development Company, and the various subsidiary development and exploration companies by which the chief controllers were able to disguise their market operations. Of these the first-named was the most reputable and is therefore chiefly blameworthy for the collapse of public confidence. In plain English, the winning of gold from the ore in the mines was completely subordinated to the share-market game, a game played with loaded dice in so far as the controlling directors and their friends on the inside obtained the earliest information from the mines and used it to buy and sell shares on the Stock Exchange. The Gold Fields company, and others in the same business, acted as 'managers' for various subsidiary mining companies and rented office-quarters, as well as the complacent kind of directors most useful for the purposes of their business. When a mine was floated in London they supplied the report of one of their own engineers and fed the press with their own puffs, when these were not written freely by editors that obtained an option on a block of shares. The gutter press of London is multitudinous and voracious, and it would not exist if shady finance did not find it expedient to provide frequent nourishment. Unfortunately not only did the 'managers', that is, the financial company that provided headquarters and a staff to the individual mining enterprise, gamble in the shares, but the mining engineers responsible for periodical reports of progress, and supposed by the public to transmit unbiased news concerning developments, did the same. Rhodesian mining decayed to the point of putrescence because it was sacrificed to share-dealing of an unsavory kind—unsavory because it was done by directors that were in the position of trustees and by engineers that were in the position of scientific witnesses. As surely as money spoils sport, so surely share-gambling corrupts the integrity of mine management. This is an old story and the telling of it may prove wearisome to those familiar with the conditions that we attack. The morale of Rhodesian mining has sunk low because those in control were hardly aware that some of the things they do are wrong, they have done them so often, and without punishment, that they have come to think of them as proper to mining. That is the pathetic feature of the position, and for it the financial press is largely responsible. Only an independent press can create healthy public opinion on such matters, and that is of slow growth. No new discoveries will justify the public in re-entering the spider's web of intrigue and chicanery for which Rhodesian mining is synonymous; a restoration of confidence will be justified only when clean management is assured.



PRIMITIVE FURNACE AND BLOWER USED AT KOLMEZI, IN THE BELGIAN CONGO

The U. V. X. and the Kolmezi

The Editor:

Sir—Your recent article on the U. V. X. bonanza, "the most remarkable discovery of ore made in recent years," suggests a reference to an orebody in Kolmezi hill, 20 miles west of the Lualaba river, in the Belgian Congo, the property of the Union Minière du Haut Katanga. This hill, first seen by white men in 1902, was a favorite place for natives to make copper, and its southern slope is covered with their workings, one of which is a trench over 1000 ft. long, 12 to 20 ft. wide, and 10 ft. deep. From a shallow shaft sunk near the middle of this trench, a cross-cut was extended south for 262 ft., of which 258 ft. was clean ore and the other 4 ft. in the barren sandstone of the foot-wall country, the line of division being sharply defined. From the floor of this cut a bore-hole was put down in similar ore, the strata dipping regularly 65° north for 147 ft., making, with 40 ft. of backs, a known depth of 187 ft., and the ore continuing below. The orebody for a length of more than 800 ft. has an average width of over 400 ft., thus covering an area of 320,000 sq. ft., or over five times the 62,400 sq. ft. of the 260 by 440 ft. of the U. V. X., but, as malachite is of less specific gravity than chalcocite, the tonnage for equal depths would be only three times as great. Sampling showed an average of between 15 and 16% copper, about equal to the U. V. X., and while large samples were taken to ascertain the contents of the two varieties of the ore, similar results were obtained from 26 samples regularly taken at 10-ft. intervals. The cut has also been sampled time and again by different visitors; it is almost a pastime there. Like results were obtained from a considerable tonnage passed through the Kolmezi smelter. This smelter is shown in Fig. 1. The waterwheel in Fig. 2 ran on bearings hand-shaped in Central Africa from bronze made by mixing Kolmezi copper with tin from a similar reduction works at Busanga, 30 miles to the north.

The U. V. X. bonanza has already made a number of men rich, while from the longer known Kolmezi orebody no man has as yet received a single dollar, and no one is likely to obtain any for years to come, as there are a great many known copper hills lying east of it along the Katanga copper belt with prior rights to crawl.

J. R. Farrell.

Oakland, January 28.

Misfires

The Editor:

Sir—I note in your issue of December 1, 1917, an article on 'Missed Holes and a Wet Shaft' by J. F. Harrington, and as we have had considerable experience with the Clover Brand fuse, I thought you might care to receive what we think might be one or two reasons for this trouble.

We had a similar case; the trouble could not be located for some time, and then we found that a poor set of fuse-cutters was being used, resulting in the fuse not being cut square and the powder-man was not pushing the fuse back into the cap before crimping. This correction diminished the trouble but missed holes continued. Finally we found that the fuse was sent down in a box on the cage and the wrappers got wet when lying in the bottom of the box. The powder-man put six rolls of fuse on a rod and started by cutting the ends from each, pulling them out the required length and again cutting all these lengths and repeating the operation until he came to the last of the fuse. He then cut all the longer lengths to the same length as the shortest piece, which left one length out of every six coils of fuse without having its end cut, and if this end had happened to be up against water, it left a wet end to go into the primer; hence a missed hole. We had this remedied and our trouble disappeared.

Another remedy which we have sometimes used, is to dip the fuse and cap into P. & B. paint rather than painting the fuse. The cap and about one inch of the fuse should be dipped into the P. & B. paint and with-

drawn immediately so as to take no chances on having the destructive liquid penetrate to the core, for should oil penetrate to the powder it would be destroyed.

Should the above not remedy the trouble, I would suggest that you secure a length of fuse from a misfire and remove the cap. You would then be able to ascertain where the failure occurred, whether at the end of the fuse which is inserted in the cap, or along the length of the fuse. When the fuse is thus opened it is easy to determine the cause for failure, namely, whether the powder-core in the fuse had been wet, or whether the fuse had the appearance of having been kinked sufficiently to destroy the water-proofing qualities.

Referring to the kinking of the fuse, I remerber a case where the fuse was laced in the cartridge in such a manner as to open the fuse sharply at this point, weakening the water-proof covering. This trouble was eliminated by placing the cap in the side of the cartridge pointing downward at an angle of 45° and tying the fuse with a string to hold it in place, thus avoiding any kinking at this point.

FRANK GROCH.

Cobalt, Ontario, February 5.

Water in Stamp-Milling

The Editor:

Sir—Referring to the question of the amount of water required in stamp-milling, brought up by H. E. West in your issue of January 5, I think the following data concerning this subject may be if interest:

The Nevada Wonder Mining Co.'s mill (formerly the Churchill Milling Co.) is equipped with ten 1400-lb. stamps, one 6-ft. Trent Chilean mill, and one 5 by 22-ft. tube-mill. It was the original intention to stamp about 7½ tons per stamp per day, but later developments showed that the Chilean mill and the tube-mill had a greater capacity; in consequence the stamp-duty was increased until during the year 1916 better than 20 tons per stamp per day, actual running-time, was achieved, and during 1917, on a much harder ore, 18.72 tons per day was the record, counting the operating time only. During this year a number of tests was made relative to the amount of solution passing through the batteries per ton of ore, and all tests checked closely, showing an average of 2.6 tons of solution per ton of ore.

This figure corresponds closely with that given by Mr. West, and if I were to answer his question as to whether or not the tonnage could be further increased by the addition of solution, I would be inclined to state that a higher ratio of solution would not increase the tonnage proportionately, in fact, I do not believe doubling the solution would increase the tonnage 10%.

Using this amount of solution a low discharge is maintained and the size of the screens varies with the hardness of the ore from day to day, and it is not uncommon to find a screen on the batteries made of heavy wire with openings one inch in the clear both vertically and horizontally. At times, when the ore is softer, a screen as small as one-half inch in the clear is used, the intermediate screen being one-half by one inch in the clear. As an illustration of the varying conditions, examination of the records will show that when the mill has averaged 170 tons per day for some particular month the daily tonnage made varied from 140 to 220, with still greater variations shown occasionally.

E. E. CARPENTER.

Wonder, Nevada, February 19.

Chinese Mineral Production

The Editor:

Sir—It is not generally known among foreigners that the Ministry of Agriculture and Commerce of China has been issuing annual statistical reports in Chinese during the last three years, and that the latest to hand, issued last year, is for the year 1914. Although discrepancies and omissions could be detected here and there, yet the ministry deserves credit in the endeavor to compile these valuable statistics, heretofore unknown in China, which will certainly improve both in form and in accuracy in the future. The value of the output of various mineral products, in terms of Mexican silver pesos, is as follows: Gold, 3,664,040; copper, 59,888; iron, 1,450,127; tin, 9,258,987; lead, 162,280; antimony, 1,061,710; cobalt, 360; manganese, 16,000; arsenic, 3480; coal, 17,268,103; nitrates, 3964; sulphur, 102,230; and talc, 28,480. The number of mines operating was 4444, in which 258,461 persons were employed. The value of the product per miner was $93, against a productive value per miner of $1062 in the United States in the same period.

CHUNG YU WANG.

Panoff Gardens, Hankow, January 2.

Fish in Arizona

The Editor:

Sir—In your article on 'The Apache Trail,' in the issue for February 23, you mention the lure of fishing in the Roosevelt lake, and incidentally name black bass and carp as existing there together. The experience of pisciculturists has been that bass, which are noble game and fight hard when caught on the line, nevertheless do not long inhabit the same waters with the carp. These creatures, which are of German origin, seem to have adopted the slogan 'karpfen-teich über alles', and devour all the small fry of bass and trout and other species, until only carp remain. Is the world-war not in progress in the Roosevelt lake?

NATURALIST.

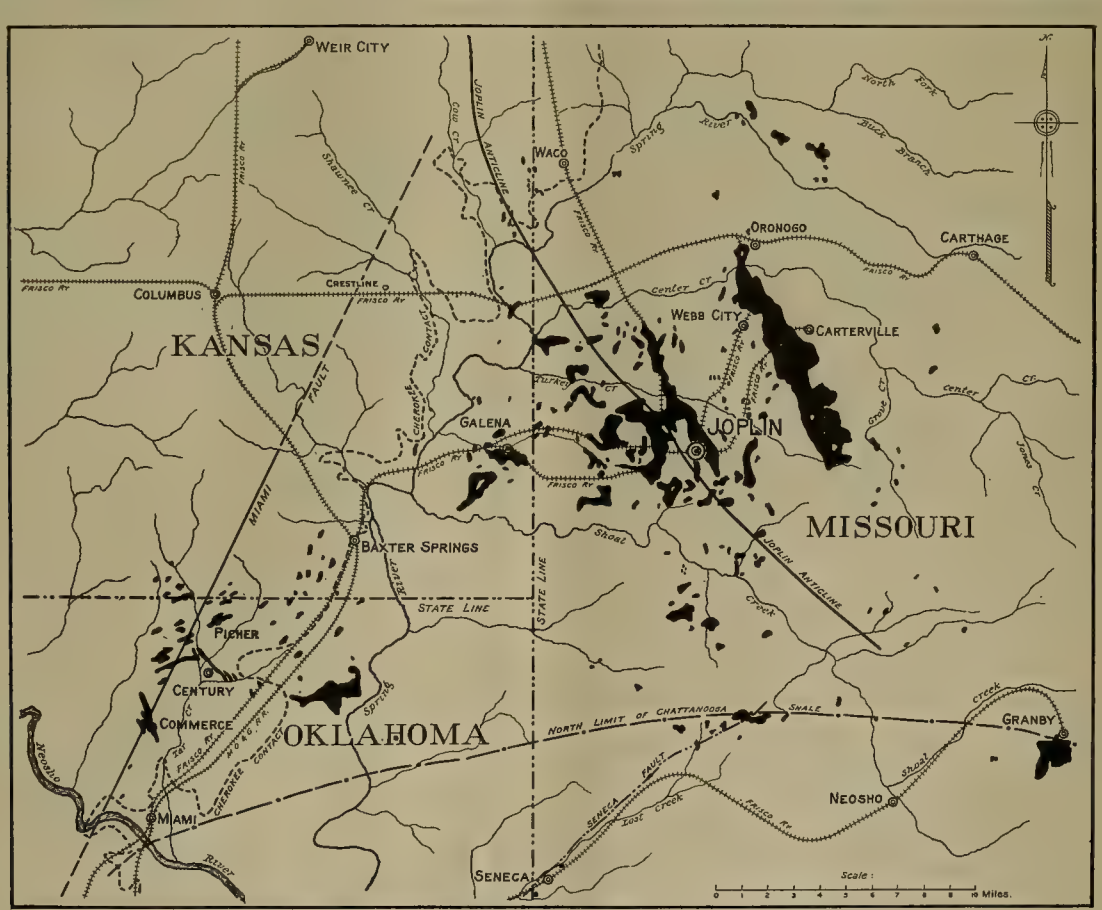
San Francisco, February 25.

HEAVY solutions for separating minerals from ores on a commercial scale have been proposed by A. Nagelvoort, who recommends bromides of arsenic in carbon di-sulphide. The bromides are recovered by the solvent action of CS_2, and the excess of the latter is separated by distillation.

The Kansas-Oklahoma-Missouri, or Komspelter, Zinc Region—I

By T. A. RICKARD

INTRODUCTION. At the outset I confess a difficulty in selecting a name to describe the mining region that is the subject of this article. I might accept the hyphenated name used on the programme of the recent meeting of the American Institute of Mining Engineers; that was 'Joplin-Miami.' This name, however, is not satisfactory because Joplin constitutes only one district out of many comprised within the area in question; moreover, its importance is declining and its prestige is dependent largely upon the fact that it is a famous locality from which mining exploration has spread through south-western Missouri into north-eastern Oklahoma; also upon the fact that many of the men interested in the Oklahoma mines have their homes at Joplin and find it pleasant to use the Connor hotel as a social rendezvous. These conditions will change when new towns and new hotels are built nearer the productive mines. The second half of 'Joplin-Miami' is even more objectionable; first, because the mines are not at Miami; second, because 'Miami' is the name of an older and more famous copper-mining district in Arizona. To give the name to two mining districts in the same country is only to invite confusion. There are ten post-offices named Miami, in the States of Arizona, California, Florida, Indiana, Kentucky, Missouri, New Mexico, Oklahoma, Texas, and West Virginia. This article will be confined chiefly to a description of mining activities in the sub-districts of Commerce and Picher, to which Century, Quapaw, and Tar River are attached; but the exploratory work already done indicates unmistakably that the ore-belt extends across the



THE KOMSPELTER REGION, SHOWING KNOWN OREBODIES AND PRINCIPAL FAULTS



UNDERWRITERS ADMIRALTY SKELTON

line into Kansas, even as far as Crestline; therefore a comprehensive name is desirable; a regional designation is needed not only to include the older districts of Joplin and Webb City, in Missouri, with the newer and growing centres of activity around Commerce and Picher, in Oklahoma, but also the operations of the immediate future in Kansas; hence I have ventured to coin[1] the name 'Komspelter', which gives the initials of the three States—Kansas, Oklahoma, and Missouri—prefixed to the trade name of the principal metal produced in this mining region.

The relative positions of the several mining centres are shown on the accompanying map. The town of Joplin is 360 miles south-west of St. Louis and 165 miles south-east of Kansas City; it is 34 miles from Miami, 24 miles from Picher, and 16 miles from Baxter Springs, the last being one of the oldest settlements in this part of the country. The area of the Komspelter region is 3000 square miles; from Springfield, in Missouri, to Miami, in Oklahoma, the distance is 100 miles; from Seneca, in Missouri, to Lawton, in Kansas, the distance is 30 miles. In days to come the limits of the known zinc-bearing area are likely to be extended even farther afield. During the period from January 1900 to August 25, 1917, this region, centring for many years around Joplin, had produced $233,000,000 worth of zinc concentrate and $44,000,000 of lead concentrate. During 1916 the combined output was worth $35,955,318, according to the statistics compiled by Otto Ruhl for the recent meeting of the Institute.

During 1917 the total output of zinc and lead concentrates was as follows:

	Tons	Market-value per ton	Total value
Blende	409,114	$70.52	$28,469,637
Calamine	29,869	41.07	1,226,975
Galena	63,931	99.70	6,377,838

Mr. Ruhl informs me also that the 'ore-prices' for zinc-blende concentrate at the end of January 1918 were $50 to $67.50; for calamine, $30 to $35; and for lead 'ores,' meaning concentrate, $85 per ton. The proportion of metal in these three products averaged 60% zinc, 40% zinc, and 80% lead, respectively.

The magnitude of the Komspelter industry can be indicated in another way. It is estimated that the capital invested in mining is $33,400,000. The average profit per ton of concentrate may be taken at $10; therefore a production of 3,340,000 tons of concentrate is required to return the capital. If an average recovery of 5% sulphide be assumed, then 66,800,000 tons of ore must be mined. Taking 15 ft. as the average working-face and allowing 14.1% of ore for pillars, then each acre will yield 45,000 tons of ore, so that to produce the tonnage calculated it will be necessary to exhaust the mineral wealth of 1485 acres per annum. This does not take account of interest; it assumes only the return of capital. To pay a reasonable interest the rate of exhaustion must be proportionately greater.

HISTORY. This is a comparatively old mining region. Lead was known to exist in south-western Missouri fully a hundred years ago, but the first mining was started in 1848 by William Tingle, in Jasper county, two miles from Joplin. This locality received but little attention at first, the principal activity being centred around Granby, where 300 shafts had been sunk by 1857. A smelter was built in 1852. The zinc mineral accompanying the lead was ignored at that time, because it had no commercial value. The Civil War interrupted work, but the completion of the first railroad, the St. Louis & San Francisco, stimulated development in 1865. About 1870 many discoveries of lead and zinc ores were made near Joplin and in 1872 the first zinc ore was marketed. By 1880 the Missouri production of lead ore had increased to 28,319 tons and of zinc ore* to 34,344 tons. In 1870 the ore-bearing ground was traced westward into Cherokee county, Kansas, and by 1877 Galena became prominent as a producer of lead and zinc. The first mining in Oklahoma was begun in 1891 at Peoria. In 1904 the first shaft in the Quapaw district was sunk and in August 1907 the first mill was completed. Railway connection

[1]See editorial in M. & S. P. of November 10, 1917.

*The use of the term 'ore' as a synonym for 'concentrate' is general in this part of the world, so that it is impossible to tell whether crude ore, broken in the mine, is meant or the artificial product made by concentration in a mill. It is a stupid localism without logical excuse.



SKELTON CHURN-DRILLS THE PRAIRIE

with Miami, on the Frisco railroad, was made in the following year. By 1913 the productive ground had been traced, by drilling and shafts, to the Kansas line.[2]

The Missouri lead region is important in the history of American mining, not only on account of its production of metals but because it served as a school of mines for training many men that made their mark farther west. For example, George Hearst and David H. Moffat started their careers in the Joplin district.

The recent story of this mining region finds its central figure in a young mining engineer, Victor Rakowsky. As is not unusual in the history of mining, the human interest of the record is at least as impressive as the industrial result. Mr. Rakowsky was born in Minnesota in 1882, and graduated from the College of Mines at Houghton in 1904. In the fall of 1909 he came from Duluth to make an examination of the Commerce Mining & Royalty Co.'s property for A. M. Chisholm. At that time Commerce could be described as an unimportant zinc-mining district linked in a loose way with the well-known Joplin district; the one was in north-eastern Oklahoma and the other in south-western Kansas, the distance between them being 24 miles. Mr. Rakowsky's examination of the group of small mines at Commerce showed that three distinct ore-channels, or 'runs' of ore, had been developed at a depth of 100 ft. He made a careful survey and recognized the parallelism of these 'runs,'' which might be described as lodes along lines of fracture in beds of chert. The deal on which he was asked to give an opinion involved the payment of $175,000 for a half-interest, $100,000 of this to be used for development and $75,000 to go to the owners He recommended the deal to his client, Mr. Chisholm, but financial conditions happened to be bad in November of that year, particularly in the timber and iron trades, in which Mr. Chisholm was heavily interested, therefore the business was dropped. Mr. Rakowsky kept in touch with the owners of the mines. Three years later, in July 1912, he obtained an option on the same property for $1,250,000. By this time two more runs of ore had been found and 16 mills were in operation on the properties of the Commerce Mining & Royalty Co. and of its lessees. The option was taken for Charles Hayden, Charles M. MacNeill, and their associates, who formed a pool and delegated the investigation of the property to the American Zinc, Lead & Smelting Co. The examination was made by H. S. Kimball and R. H. Polhemus, who advised exploratory work and were placed in charge. Operations were concentrated on the extension of the known runs and as no more ore was uncovered during the four months of the option it was dropped after spending $18,000. No drilling was done on the outside acreage.

Mr. Rakowsky remained at Miami, which is six miles south of Commerce. Still confident that the locality promised good opportunities for profitable mining, he secured leases from Clyde Fullerton and W. W. Dobson, who controlled ground in the northern part of the district along the Miami fault, the axis of the ore-belt. He leased 3500 acres on a royalty of 12½%, without a bonus, but with the privilege of testing the ground for a year, and longer if his work proceeded continuously. Fullerton and Dobson had obtained their title from the Indians owners of the ground, paying sums ranging from $50 to $200 per lease of 200 acres; they knew that Rakowsky had conducted the negotiations with the Commerce people and they were willing to give him a chance to promote a large enterprise. Rakowsky placed the business before O. S. Picher, president of the Picher Lead Co., a firm engaged in the manufacture of pigments at Joplin and now consolidated with the Eagle Lead Co. of Cincinnati. Mr. Picher was anxious to increase his supply of lead product for the sublimation process and was already interested in the development of lead ore in the Joplin district; he knew, from his purchase of ores coming from the Oklahoma mines, that their output contained a proportion of lead larger than the Joplin ores; so he closed a deal with Mr. Rakowsky. The latter was put in charge of the exploratory work, being paid a salary and remaining under contract from October 1913 to January 1915, by which time he had proved 2,000,000 tons of 8% ore, that is, ore from which 8% of zinc and lead could be recovered in the mill. This successful demonstration of the local mineral resources was made on

[2]'Silver, Copper, Lead, and Zinc in the Central States in 1914,' by B. S. Butler and J. P. Dunlop. U. S. Geological Survey, 1915.

the orebodies that are now supplying the Netta, Crawfish, Bingham, and Whitebird mills.

In 1915 Rakowsky sold his equity and severed his connection with Picher. He then secured options in Kansas, on ground adjoining the Picher property, to the extent of 4500 acres on 20-year leases at 5 to 7% royalties. This business was submitted to J. L. Bruce of the Butte & Superior Mining Co. Mr. Bruce represented D. C. Jackling in the deal and formed the Miami Zinc Syndicate to conduct operations, which were commenced in June 1916. This work is still in progress and Mr. Rakowsky, I am glad to add, retains an equity in the property, so that he will participate in the success of it. The immediate result of exploration has been to prove the extension of the ore-belt from Oklahoma north-eastward into Kansas. Since the summer of 1916 Mr. Rakowsky has acquired leases along the projection of the Miami fault and in December of that year had secured 25,000 acres under first lease from land-owners in Kansas on royalties ranging from 5 to 7½% for a distance of 21 miles north-east of the Kansas-Oklahoma line. These leases have been transferred from the Jackling syndicate to the American Metal Co., which is now operating drills, and was expected to begin mining at three points before the end of 1917. Another suggestive discovery has been made at the extreme north end of the known zinc belt, near Waco, on the border of Kansas and Missouri, where a run of ore is being tested by local people, namely, P. B. Butler, T. J. Franks, and Frank Danglade. Mr. Rakowsky is also interested with O. M. Bilharz in the successful exploitation of the Bluebird, Shorthorn, and Chapman properties, which are now among the leading producers of the so-called Miami field. His faith has been splendidly justified and he has the satisfaction of knowing that the honorable part he has played in the development of this important mining industry is recognized by the community in which he lives.

It is worthy of note that the Commerce Mining & Royalty Co., which negotiated in 1909 for the sale of a half-interest at $175,000, has recently* given an option on a part only of its holdings for $5,000,000. Among other incidents of the boom I may refer to the good luck of Philip N. Moore, president of the American Institute of Mining Engineers. He and his friend C. P. Perrin acquired control of the Admiralty group, covering 100 acres, in 1915. They paid less than $100,000 for the leases and 20 months later sold their rights through Mr. Rakowsky to Cosden, Aiken & Curtis, for $600,000. In March 1917 Bulkeley Wells, representing the Metals Exploration Co., of Boston, bought leases on 180 acres, also through Mr. Rakowsky, for $250,000. It is evident, therefore, that he has played a notable part in starting intelligent exploration and in the later transfers of property.

The mention of the Indian owners of the land draws attention to an interesting feature of industrial development. In Ottawa county, the county in Oklahoma that is the scene of the principal mining activities, there are seven Indian tribes, but of these the Quapaws are the only ones fortunate enough to own mineral-producing lands. The allotments were made to them in 1896, in compensation for vague rights pertaining to them as aborigines. When they were restricted to this 'reservation,' each male adult received 240 acres. In 1897, by act of Congress, the Indians were permitted to lease their lands for mining purposes for a period of 10 years, but at that time there was no immediate prospect of using this privilege profitably; not until eight years later were rich deposits discovered under the surface of the prairie. The original leases were obtained for the purpose of drilling for oil, attention having been attracted by the tar seen on some of the water in this region. At that time the Quapaw reservation was the greatest producer of prairie hay in the country. The reservation extends southward six miles from the Kansas line into Oklahoma. In Kansas all the land is held by whites and no repetition of the Ottawa county experience is possible.

When ore was found a hundred feet below the surface the Indians were easily persuaded to grant leases on small royalties, say, 5% of the smelter returns; the local lessors were quick to sell their rights to speculators, who paid them absurdly small sums, from $25 to two or three hundred dollars, and then in turn sub-leased the ground on royalties of 10 to 15% to real mine-operators. The Indians did not cultivate the land; for 50 cents per acre they would sell to a white man the right to cut the crop of wild hay that usually represented the only produce of the soil. Here and there, along the bottom lands, bordering the small and sluggish streams of this flat country, small areas of cultivation devoted to corn and sorghum might be seen, but in a broad way the region could be described as untamed prairie. For example, a State official[2] purchased for $250 the mineral rights on land belonging to Wah-tah-noh-zhe, a squaw, who had leased the land on a royalty to the Miami Royalty Co. This State official became the recipient of tribute while the Indian woman received $250 in cash, which seemed to her lots of money and a more assured profit than the uncertain proceeds of mining operations that she did not understand. Her ground happened to become the site of the highly productive operations of the Turkey Fat mine, which paid the State official $100,000 in royalty in a short time. Such impositions on the ignorant red people are no longer permitted; now their business is supervised and they are protected by a Federal agent. For several years the Quapaws were the only tribe of Indians that did not have to submit their arrangements, for disposing of land, to the Secretary of the Interior. This was a 'joker' perpetrated by ex-Governor Crawford, of Kansas, and A. B. Abrams, of Baxter Springs, a New York Indian with Hebrew blood. Abrams had managed

*This was written last November. A delay in obtaining supplementary data has prevented the prompt publication of this article.

[2]'A Mine-Owning Tribe of Indians,' by Lucius L. Wittich. M. & S. P., July 17, 1915.

to lay hands on 1700 acres of land in north-eastern Oklahoma and had become secretary of the Quapaw tribe. The ex-Governor secured 160 acres of land at Lincolnville, on which tract the rich Omaha-Petersburg mine is now situated.

Among the transactions worthy of mention, as illustrating the easy pickings available on this ethnic island of real Americans, I may mention how Harry Crawfish, a buck, sold for a song his mineral rights to the ground on which the Picher Lead Co. has developed several splendid mines. For a few hundred dollars Julia Greenback, a squaw, disposed of a lease out of which the Lost Trail mine has won zinc-lead ore to the amount that under a fair royalty would have yielded her $20,000. Netta Trak, an Indian girl, owned an allotment of 200 acres; this was bought at auction in 1911 for $9200, or $46 per acre, by O. J. McConnell, associated with W. B. Thompson. The purchase was subject to a lease at 6% royalty payable to McConnell. This lease was sold on a 12% royalty to O. S. Picher, the fee simple being sold by McConnell to others for $200,000, or $100 per acre. The Netta is one of the most productive mines in the district.

In course of time, under the tutelage of their protector, the Federal agent, the Indians learned how to take advantage of the opportunity given to them by a bountiful providence, assisted by the U. S. government and the intelligent energy of the white miner. Benjamin Quapaw is receiving $20,000 per month as royalty from ore mined under his allotment of 200 acres. Emma Gordon, who owned a similar allotment, married a 'mucker,' Hiram McBee, a Scot, who had been 'fired' from a mine working on that particular allotment. When he married the bronze landlady he did not revenge himself on the mining company; on the contrary, he conceded a full extension of the lease. He is dubbed "a real gent from Oklahoma." His income is $25,000 per month, the tribute on a 20% royalty. The half-breed to whom Mr. Moore paid $6000 royalty per month bought farm-mortgages in Kansas and two automobiles. These Indians are great motorists, in the sense of owning cars. The story is told that Jim Good Eagle bought a six-cylinder car at Joplin. A few days later another Indian went to the same agent and asked: "Jim Good Eagle, he buy car how many cylinders?" The agent said, "Six." To which the Indian replied, "Jim Good Eagle him no good; got no money; I buy nine-cylinder car." During the meeting of the Institute in this district early in October it was arranged that the Indians should give a dance on the occasion of a breakfast that was served on the Blue Mound, a hillock from which a good view of the prairie and its new mining industry could be obtained. The Indians came in blankets, but they drove their own high-power cars. Somebody exclaimed, "Poor Lo is riding on high." Shades of Alexander Pope!

> Lo! the poor Indian whose untutored mind
> Enjoys the tribute from another's find;
> His soul proud Science never taught to stray
> Beyond the zinc-ore price of yesterday.

Scenery and Roads. The view from the top of the Blue Mound near Picher reminded me of looking upon the Sons of Gwalia mine and its environs as seen from Mount Leonora. Indeed, there is much about this region to recall Western Australia. The country is flat; it is dusty; the roads follow the section-lines, so that straight vistas are frequent, like the clearings that follow telegraph lines across the Westralian desert. They form aisles through the stunted forest—oak and elm, between Picher and Joplin—mulga and titree between Coolgardie and Menzies. The excitement of successful mining furnishes the electric atmosphere common to both regions; in both a few aborigines remain to remind the white man that he is an intruder, but the aboriginal American is as much superior to the Australian black as the conditions of life generally are more favorable on the prairie than in the desert. In 'W. A.,' as they call it there, we had to get our drinking-water by distilling the brine of shallow wells; in Oklahoma good water is plentiful, even if anything more potent is under prohibition. The scenery, if alike in its flatness and its stunted forest, is more urbane near the zinc mines than the thinly veiled aridity of the Australian hinterland, in which so many men have died of thirst in their hunger for gold. When I was in Western Australia the ship of the desert, the camel, was the most picturesque means of transport. In the Komspelter region the motor-car is supreme. Three hundred taxicabs ply between Joplin and Miami; they bring 3500 people to Joplin on a Saturday night, many of them to the 'Connor,' which was built out of royalties by an Irishman that perpetuated his name honorably by building a handsome hotel. As for automobiles, there is an endless stream of them on all the principal roads. They pass at the rate of one car per minute; the main streets of the little mining settlements are cluttered with them; it is estimated that 2500 cars per day make the 24 miles between Joplin and Picher in 90 minutes. No wonder the roads are dusty, for they spread over the prairie wherever convenient. It is true, a beginning at road construction has been made in the environs of Joplin, and I am told that large sums of money have been voted to build a real road from Joplin to Miami, but in October last this improvement was still in the lap of the future. Meanwhile the mining industry suffers from being conducted 40 miles from the business centre; the managers travel in open touring-cars over the rough and dusty roads, injuring their eyesight and returning in the evening covered with grime, burnt by the sun, and buffeted by the wind of rapid transit. The technical staffs come into town on Saturday afternoons and return to the mines at 10 o'clock on Monday morning; the loss of time and energy due to this migration, daily for some, weekly for others, is a serious tax on their efficiency. An electric trolley-line is being built; this will be a boon. A system of light electric railways along the mining belt should be useful and profitable. These will help, but it is obvious that the technical men should live nearer the place of their work.

(To be continued)

V-Notch Weir Measurement

By D. ROBERT YARNELL and G. A. BINZ

*Weirs of various types are familiar to hydraulic engineers, and employed by them for the measurement of the flow of streams and of large volumes of flowing water. Fig. 2 shows a comparison of the flow-curves obtained when using various types of weirs. The rectangular form is most popular for large flows at a rather constant rate. It has been found less suitable for boiler-feed measurements, because different co-efficients have to be used for different ratios of width to height, and because the rectangular notch furnishes small motive-power at low rates of flow. The V-notch obviates both these objections. Its accuracy is essentially the same at all rates of flow. The curve also shows that, at low rates of flow, the head increases rapidly for small increments in volume. The V-notch is therefore an ideal weir for boiler-room measurements, and has become universally adopted for this purpose. Measurements of flow by means of the V-notch are based upon the well-known formula: $Q = KXH^5$ in which

Q = quantity flowing in a unit of time.

K = a constant.

H = height in inches of liquid flowing through weir.

The flow, therefore, is not directly proportional to the head, and some compensating device must be embodied in the recording-mechanism, if, as is desirable, the recording member shall travel equal distances on the chart for equal increments of flow. Various methods have been proposed with this in view, and a few of the more important ones will be briefly described. These methods may be divided into the following groups:

1. Instruments which use a plain float, and employ some intermediate method for correcting the travel of the pen on the recording-chart.

2. Instruments in which the compensation is provided in the shape of the weir, or where a float of special construction is used to secure equal rise for equal increments in flow.

3. Instruments operated electrically.

4. Instruments which weigh the liquid.

Commencing with group No. 1, probably the forerunner of the best-known V-notch meters was that designed by James A. Gardner and built by the firm of Glenfield & Kennedy, Ltd., of Kilmarnock, Scotland. The idea underlying the construction of this meter is as follows: The length of a pendulum H, which controls the escapement of the integrating device, is made to vary as the 5/2 power of the head of liquid in the notch. This is accomplished by causing the suspension-carriage E of the pendulum to ride on a cam D, made to rotate as the float rises and falls. The device is so adjusted that there is no movement of the integrator when the float is at zero. As the float rises, the pendulum is shortened and the clock-escapement, which it controls, runs more rapidly. No chart-record is provided. Great delicacy is probably the principal disadvantage of this ingenious design. Next is the Lea meter. With this a cam is interposed between the float and the recording-chart. The cam is in the form of a drum carrying a screw-thread with variable pitch so calculated that the pen will be caused to travel equal distances on the chart for equal increments of flow. Another meter which uses this method of correction, but employs a spiral groove cut upon the surface of a flat disk, is the Cochrane (Fig. 4). The float is suspended from the cord S wound around drum B and counterbalanced by weight W. The cam-disc is mounted on the same shaft B and rotated when the float rises or falls, thus moving the carriage D to which the recording pen and integrator are attached.

Another group comprises those in which the correction, necessitated by the fact that the quantity of water flowing through a V-notch is as the 5/2 power of the head, is made directly by shaping the weir or the float employed. One of the earliest methods of this kind is the weir designed by Wilfred Yorke, an Englishman (Fig. 5). This is so designed that the area varies as the square root of the height, and therefore the quantity of water flowing varies directly as the head. It has been found in practice that this weir cannot be shaped in accordance with calculated curves, as the varying effects of contraction and other disturbing factors have to be taken into consideration. It is therefore made in accordance with empirical determinations. The same principle is employed in a weir formerly manufactured by the Kennicott Co. (Fig. 6), where the water falls through a specially shaped slot, and for equal divisions of head A, B, C, D, and so on, the area added for the passage of water to the interior of the weir grows progressively smaller as the head increases. Both of these were found in practice to show considerable inaccuracy at low flows. Of meters in which the compensation to the chart-reading is obtained by employing a specially shaped float, probably the earliest was invented by J. W. Ledoux and built by the Simplex Valve & Meter Co. (Fig. 7). In this meter the buoyancy of the float is successively changed by causing the lower conical portion of the float to displace a varying quantity of mercury contained in M. In this way the effective weight of the compound float-system is successively decreased in such manner that the float will travel equal distances for equal increments

*Abstract: Proceedings Engineers' Club of Philadelphia from paper read before the Philadelphia Section of A. S. M. E., April 1917.

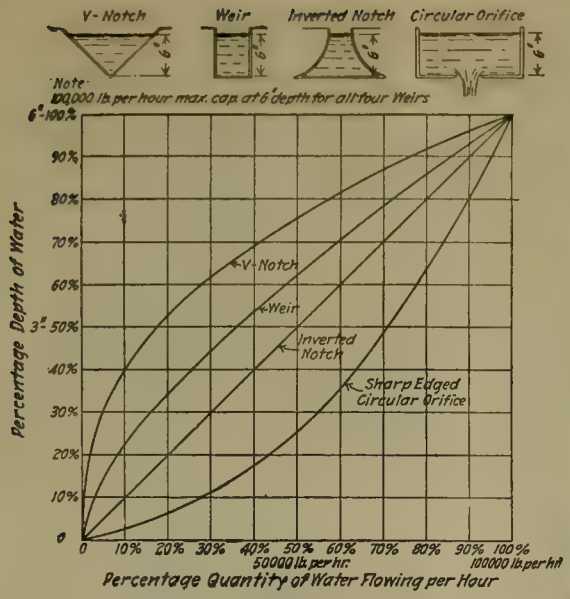


FIG. 1. CURVES REPRESENTING DIFFERENT WEIRS

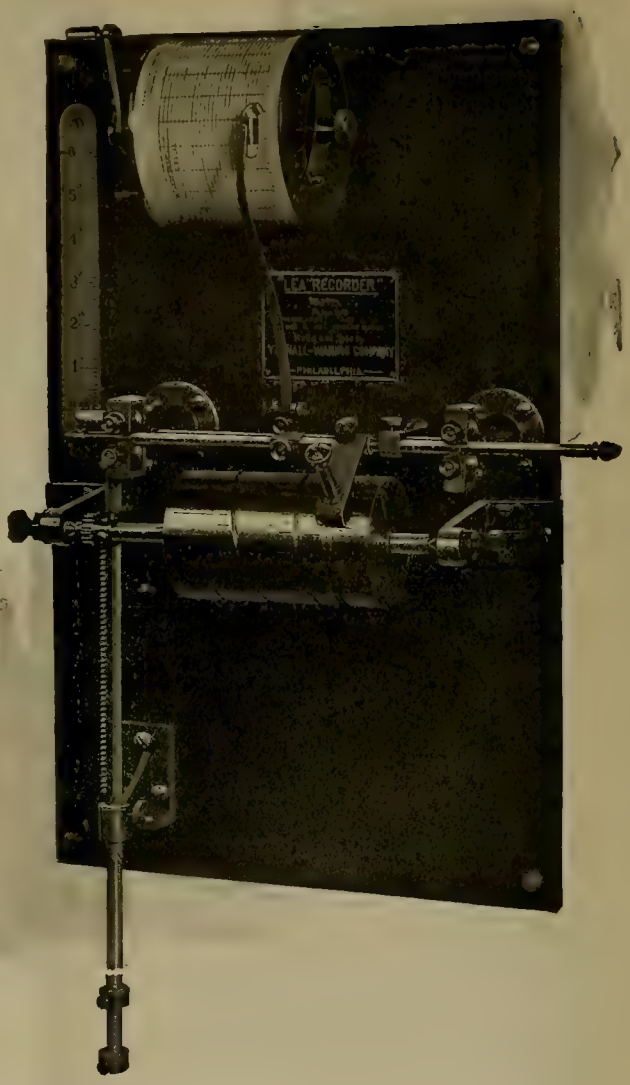


FIG. 3. RECORDING MECHANISM OF LEA METER

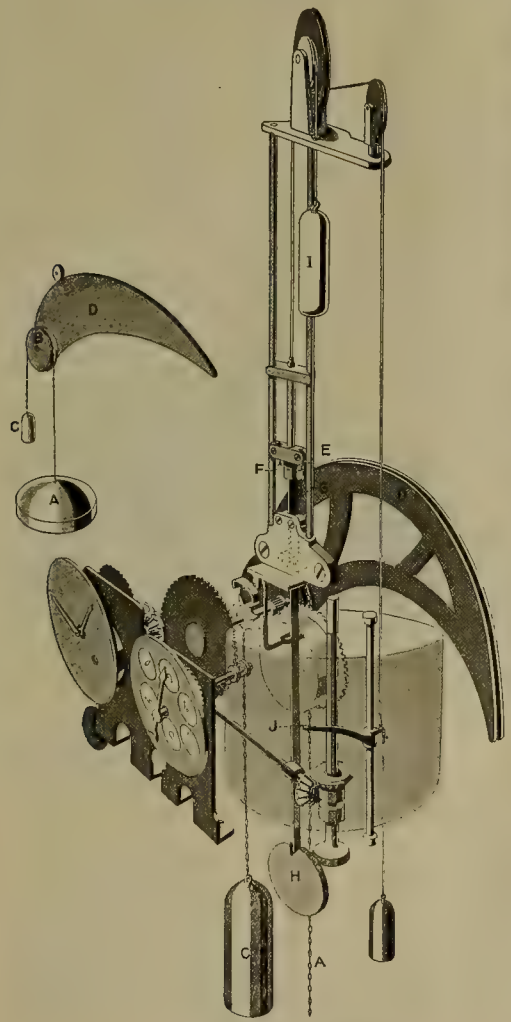


FIG. 2. THE GARDNER METER

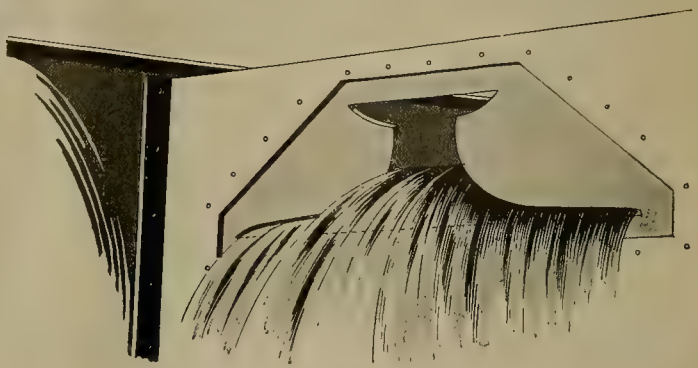


FIG. 5. THE YORKE INVERTED WEIR

in flow. Another form employing this principle of changing buoyance is found in the ingenious design by E. G. Bailey, of Boston. Here two displacement-bodies are used, suspended on opposite ends of a scale-beam that is pivoted on knife-edges. The two bodies are so adjusted that they rest on the surface of the water when no water is flowing through the notch. In this position both bodies are of equal area, displace equal volumes of water, and are therefore balanced. The cross-section of one of the bodies increases upward, whereas that of the other diminishes. As the water rises they therefore displace different volumes of water, and one will sink lower than the other before equilibrium is restored. A turning motion of the scale-beam results, which is transmitted to the recording chart. By shaping the contours of the two bodies, their motions are made to conform exactly with the 5/2-power curve of flow.

Of electrically-operated devices, only one has come under my notice; namely, that proposed in 1914 by Rateau, the inventor of the Rateau turbine. The head, in this case, is measured by the difference in level in a mercury U-tube. The leg in which exists the lower level carries a resistance-element, such as a high-resistance wire wound upon an insulator. This element is made part of an electric circuit in which is included a special differential millivolt-meter. As the mercury rises and falls in the leg of the U-tube, more or less of the resistance is cut out of the circuit, and the amount of current flowing may be caused to vary in accordance with the curve of the rate-of-flow.

The last group of meters comprises those that weigh the water as it flows through the weir. It must be conceded that, so far as the operation of a power-plant is concerned, this has much to recommend it, seeing that it gives its information directly in pounds of water. It will be seen, however, that the task of weighing the flowing water is difficult, necessitating a complicated form of apparatus. A typical example is the meter made by the Hoppes Manufacturing Co. (Fig. 8). This consists of a weighing vessel *W*, of special shape, suspended on a spring-scale. It has flexible connections to the weir-chamber *A* and to atmosphere *B*, and is so arranged that the scale is balanced at zero when no water is flowing through the notch. As the water rises in the weir, it also flows into the weighing-vessel and, owing to the special shape of the latter, pulls on the scale in exact proportion to the rate of flow.

In the Lea meter, as built today, the water to be measured enters the inlet-compartment of the steel or cast-iron tank, through a balanced control-valve, passes under a baffle into the approach-chamber, and thence through the V-notch weir into the large storage-compartment below. A pipe connecting with the bottom or end of the storage-chamber takes the water to the feed-pump. This design of tank, with a storage-chamber extending the full length under the inlet and approach-compartments, is patented. It possesses several notable advantages. It provides an exceptionally large volume of water for pump-storage, a long approach to the weir insuring accurate measurements, and, moreover, by regulating the inlet with a float or bucket balanced upon this large pool, it is possible to secure easily readable charts. One corner of the inlet-compartment is partitioned off to form a still-chamber for the float. This chamber is connected with the weir-compartment by a small opening protected by a strainer. A very large and powerful seamless copper float rides upon the surface of the water in this still-chamber, and conveys its motions to the recording instrument mounted on the tank. In order to secure equal divisions on the chart, the recording-pen is not attached directly to the end of the float-rod, but an ingenious compensating mechanism is interposed between these members. As a check upon both the recording and the integrating mechanisms, a scale is fitted into each instrument, on which a pointer, attached to the end of the float-rod, indicates the height in inches of the water flowing through the notch at any time. By inserting this figure in the formula heretofore given, the accuracy of the instrument may be readily checked at any time while in normal operation. One American development of metering feed-water with the V-notch deserves brief mention. This is a metering heater, consisting in the standard Webster open feed-water heater which is combined with the Lea meter, the water, after being heated by the exhaust-steam, passing through an outside connection and the usual balanced control-valve, to the metering section. A considerable saving in floor-space and a conservation of heat-units result from this combination.

A Lea recorder was installed in the hydraulic laboratory of the University of Pennsylvania, directly connected to the cylindrical steel pressure-tank. This tank was over 5½ ft. diam., and 37 ft. high. A stand-pipe with numerous overflows was provided, by means of which the head on the discharge-pipe could be varied at will by 2-ft. intervals. The meter discharged into an open flume, which carried the water to the large weighing-tanks on the floor below. These tanks were of steel, and had a capacity of about 15,000 lb. each. They were supported on accurate scales, sensitive to a weight of 5 lb. An efficient system of hydraulic valves allowed instant change from one tank to the other. The tanks could be emptied in 35 seconds. A hook-gauge was attached to the weir-chamber of the meter, and independent readings were taken every five minutes. The temperature was recorded on the same chart as the water by means of a recording thermometer fixed in the meter-case and checked at frequent intervals by a mercury thermometer. All readings were double-checked. A varying flow was obtained from practically zero to a considerable overload, thus reproducing power-plant conditions. The results are summarized below:

Total water weighed, pounds	154,559
Area of chart by planimeter	4.23
Scale of chart	36,312
Total water by chart, pounds	153,599.76
Error of chart-record against water weighed, per cent	0.62
Total water by integrator-reading, pounds	156,500
Total error of integrator, per cent	+1.256

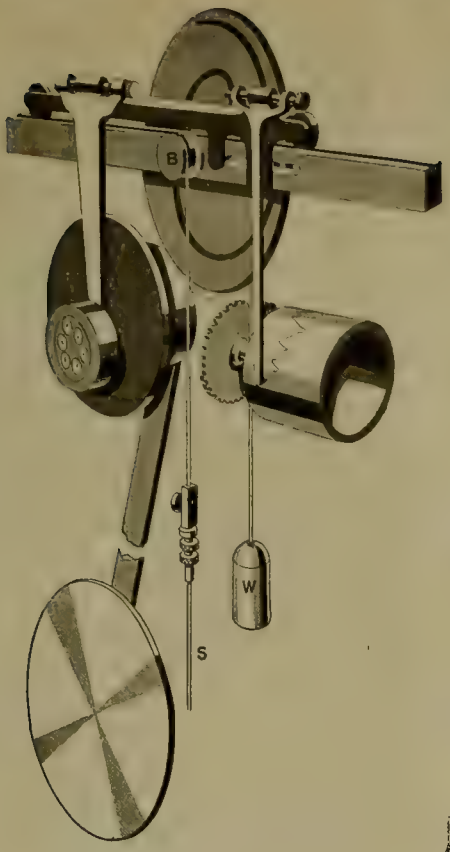


FIG. 4. COCHRANE RECORDER

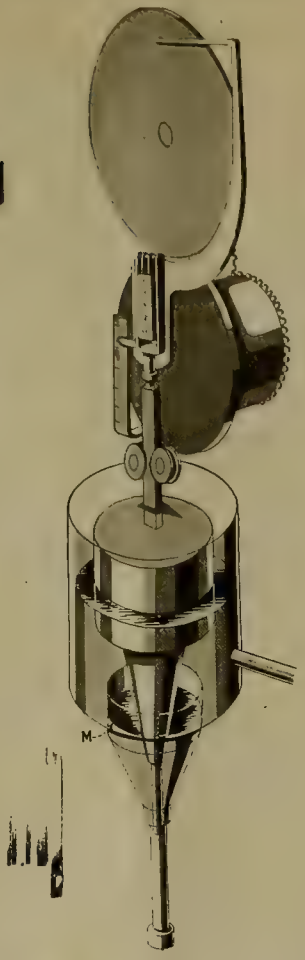


FIG. 7. SIMPLEX RECORDER



FIG. 9. INDEPENDENT LEA METER

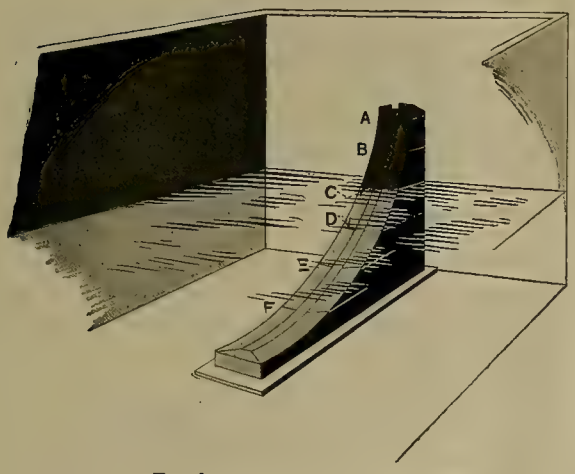


FIG. 6. KENNICOTT CYCLOIDAL WEIR

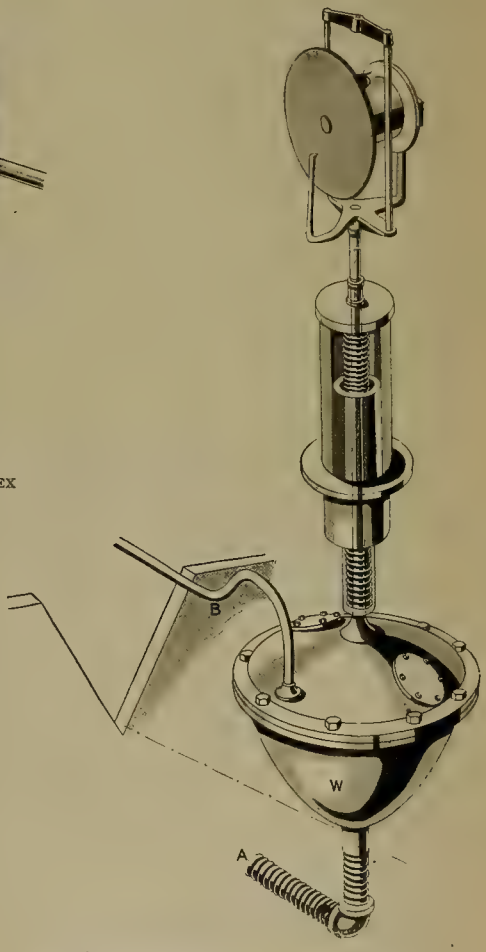


FIG. 8. HOPPES RECORDING SCALE

As pointed out by J. W. Ledoux, it is not generally realized, even today, that the measurement of water flowing through a V-notch is an exceedingly difficult problem. While there are a number of practical, and reasonably accurate, meters available in the market, all of them are capable of improvement. The results of the test given above show a high degree of accuracy. It should be noted that such closely correct measurement might not be obtained when the meter was running at a constant rate within 1% of the maximum flow.

FLUO-APATITE has been made synthetically by fusing sodium phosphate with fluorspar, and also by heating calcium phosphate with potassium fluoride and chloride.

Mining Conditions in Chile

By FRITZ MELLA

The year 1917 has witnessed no development of new mining enterprises of note. In copper, the Chile Exploration Co. at Chuquicamata, and the Braden Copper Co. at Rancagua, are of course by far the largest producers in Chile, the former with an output of about 4000 tons of electrolytic, and the latter with 3000 tons of blister monthly. The Braden company has under construction a new reduction plant with a daily capacity of 10,000 tons of ore, and Chuquicamata will increase the present 10,000-ton plant to 30,000 tons. It is of interest to observe that, with the gradual improvements made in the crushing and chlorine-elimination departments, as high as 13,000 tons of ore has been put through the Chuquicamata plant in 24 hours, and, were it not for the fact that the shortage of fuel-oil on the coast is restricting operations, this plant should easily handle between 11,000 and 12,000 tons of ore daily.

The Catemú and Naltagua smelters near Santiago, both operating with French capital, are producing from 250 to 300 tons each, of blister copper monthly, chiefly derived from ores produced from their own mines. Both of these companies recently commenced smelting in modern reverberatories, fired with coal-dust, Naltagua having two 5-ft. furnaces and Catemú one of like dimensions, although the latter company has an 80-ft. furnace under construction which it is hoped will be blown in shortly. The furnaces are running satisfactorily, and as they are equipped with waste-heat boilers, a material decrease in smelting costs, as compared with their blast-furnace practice, should be effected. The Catemú company is successfully floating its low-grade ores from the Los Mantos mines in an 80-ton plant. Also a 50-ton flotation unit for handling the ores from the Melon district is being erected at Chagres, adjoining the smelter site.

Other custom smelters operating are the Panulcillo, owned by the Central Chile Copper Co., the Guayacán at Coquimbo, recently acquired by the American Metal Co. from the Cia. Chilena de Fundiciones, and the Caldera plant in the port of Caldera, acquired by the American Smelting & Refining Co. from the Edwards interests. Notwithstanding that Chile is apparently well supplied with custom smelters, and that the price of copper would appear to be attractive, the high rate of exchange, the excessive cost of materials and ordinary commodities, combined with the low prices paid for ores, have combined to oblige practically all the small mines to shut down; and they are not a few. In such districts as Copiapo, Coquimbo, and La Higuera, the situation has become sufficiently acute to provoke a discussion in Congress regarding the advisability of establishing government owned and operated custom smelters. It is difficult to understand why plants operated by the Government would relieve the situation without having to operate at a loss, but the near approach of election time may have some bearing on the fact that the measure is being patronized by the congressmen from the affected districts. Quién sabe?

Gold and silver mining are of minor importance, the small amount of gold produced coming almost entirely from placer workings in the southern provinces.

The coal-mining companies in the south of Chile are enjoying an era of prosperity, and until the recent determination of the allied governments to place the purchase of nitrate in the hands of one reliable agent, in order to eliminate competition in prices, the producers generally were wearing extensive smiles. At present the market is weak and uncertain, with few transactions, and very little demand. The outlook, consequently, is gloomy. A short time ago a paragraph in the Mining and Scientific Press announcing the Government's intention of organizing the purchase of nitrate, stated that there was no justification for the high price prevailing, but I am sure that the assertion was made without an intimate knowledge of local conditions in Chile. It is a well-known fact that the major portion of the cost of producing nitrate is the item of fuel, as all the raw material must not only be crushed, but boiled as well, in order to dissolve the sodium nitrate. In the last few years almost all the producers have adopted fuel-oil in preference to coal, and as the price of Californian residuum and Mexican crude (and crude it is, since most of it must be heated before it can be pumped) is now 50 shillings per ton as against 42 shillings at the outbreak of the War, this item alone is sufficient to influence the cost of the finished product materially. A further influential factor, which cannot be side-stepped, is the fluctuating monetary exchange. When nitrate commanded a much lower price than at present, a producer was able to buy from five to six Chilean pesos for an American dollar, while today the purchasing power of a dollar is about three and a half pesos. Unfortunately the rise in exchange was not accompanied by what should have been the logical drop in prices, nor has the price of labor been lowered. On the contrary, the increased cost of commodities has been accompanied by a demand for higher wages which has been generally met by the employers, and as the nitrate producer pays his labor in pesos his cost of production has increased enormously. I imagine that 12-shilling nitrate in Chile must look to some people in the United States like 23½c. copper to a Government price-fixing committee.

Summarizing the case of the Virgilina copper deposits, on the line between Virginia and North Carolina, F. B. Laney, in a monograph just issued by the Virginia Geological Survey, says that the hope of the district is dependent upon consolidation of the various ownerships. A large and complicated plant is not warranted by the size of any of the mines as now held, and in order to secure economy large tonnages of ore must be treated. It would appear that flotation has given good results, but that it must be supplemented by other methods to yield high recovery.

The Duties of a Shift-Boss

By JOSEPH P. HODGSON

The object of this address* is to assist the shift-boss. Having served in that capacity myself, and having some knowledge of the things expected of the shift-boss, I have no hesitancy in saying that I know his duties are many and important, and if he is a real shift-boss and has a proper conception of his work, he is, without doubt, one of the most valuable men in the employ of the company. If, however, he is only a driver of men, it is quite possible he may be a positive injury to both the company and the men. Of the former type (real shift-bosses) I know we have a goodly number. Of the drivers only, if we have any, and I know there are very few, I sincerely hope they may soon be real shifters in the truest sense of the word.

The shift-boss is the man who stands between the company and the men. He represents the company to the men and interprets its policy. Consequently, the duties of a shift-boss are varied and far-reaching, and go beyond the ordinary idea of 'getting out the rock.' In working large orebodies of uniform grade his principal duty is to look after the tonnage and, when necessary, to crowd the mine for a still greater tonnage. At a mine like the Copper Queen it is entirely different. Here the shift-boss has many other problems and often he must use his individual judgment. Of these considerations, the one of greatest importance is the work itself.

While the individual responsibility for the employment of men has been removed from the shoulders of the foremen and bosses by the substitution of a central employment-office under the direction of a man whose object is to secure the most intelligent and best-trained men available for the work, the opportunity and duty of the foremen and bosses to "fit the man to the job" are still of supreme importance. In fitting a man to the job the first question which presents itself is, what are the man's capabilities? For example, can he tell ore from waste? Is his temperament such that he unconsciously wants to make a 'big showing' and, consequently, fails to sort the ore as clean as possible? Is he physically strong enough to stand up to the job, or can his intelligence be used to better advantage in some other direction? As, for instance, a man physically able to make a splendid worker in a sulphide stope when there is no sorting to be done might be absolutely wasted in mixed ore requiring careful sorting. Of course, over half of the work requires no particular knowledge of ore on the part of the man, and this fact should not be lost sight of in judging a man's value for this part of our operations. In development work, a man trained in railroad tunneling, underground drifting and raising, or similar lines, will be better fitted for this field than one trained in 'chloriding.'

So far, we have considered only the question of selecting men already trained. As a matter of fact, in recent years, with the tremendous expansion of metal-mining operations in the West it is becoming increasingly evident that the supply of trained men is practically exhausted, and to meet this condition it is necessary not only to select men but to train them for the job; and it is here that the bosses have their largest opportunity for valuable service. Bosses themselves are selected as much for their knowledge of how to do the work and how to instruct others to do it as for their ability to handle men. These questions of the selection of the man for the job and his proper training are, in a way, only secondary to the real constructive work of the boss. A carpenter selects his materials, tools, and methods for the particular job, but first of all, he must have a plan to work to. Similarly, the boss must have his plan complete in every detail for his run, fitted into that of the division foreman, whose plan, in turn, is fitted into that of the general foreman, and so on, each portion, as it were, dovetailed into every other until the whole makes a complete self-contained scheme of management able to take its stand in the mining world—a finished structure, well designed and efficiently operated. As some one has aptly said "the authority to issue an order entails the duty of seeing that the order is carried out." Naturally, this involves, besides the knowledge of how to carry it out, careful planning, as otherwise the issuer of the order will not know whether it can be carried out or not. For example, a man may be sent into a drift to drill a round of holes and finds only part of the outfit. He spends a couple of hours rustling the rest of the outfit, fails to get in his round and is seriously reprimanded, or, perhaps, in extreme cases, discharged for something that was not his fault, but entirely due to the failure of the shift-boss to work out a comprehensive plan in advance of issuing orders.

In the second place, it is the duty of every boss to do justice to the mine itself. First of all in regard to the method of extracting the ore: Small bodies of ore may be easily overlooked that may be connected to larger ones that would mean hundreds of thousands of dollars to the company. Of course, there are so many prospects that it is impossible to follow out each so-called break or stringer of ore. Nevertheless, it is the duty of the shift-boss to try to recognize a good prospect and report it to his foreman, so that the combined judgment of both men

*Delivered before the mine-foremen and heads of departments of the Copper Queen branch of the Phelps Dodge Corporation at Bisbee, Arizona.

will be exercised. This is an important consideration when we think that the life of the mine is really at stake and that it may be lengthened or decreased according to good or poor mining—in other words, lack of conservation of the orebodies.

The third consideration is vested in the proper interpretation of the company's policy. In general, the policy of this company is well known. It is to pay good wages in order to have the men contented and at the same time to operate the mines on a good business basis, so as to reap the maximum amount of profit. The attitude of the shift-boss may turn the feeling of the men either for or against the company. In fact, the popularity of the company is really at stake between the bosses and the miners.

Fourth is the importance of handling men. Every shift-boss should make a study of his men. First in regard to their ability, so as to fit the right man in the right place; and, second, in regard to discipline, so as to get his goodwill and his interest in the work, and at the same time have all orders obeyed. At this time when wages and bonuses are higher than they have ever been in the history of the district, there is a natural feeling that superhuman efforts must be made to maintain costs at their former level. Obviously, if good work was being done before the increase of wages, costs could not be held down by simply attempting to increase the efforts on the part of the men. The policy of the company in paying these wages is not to obtain the privilege of driving the men any harder, but is to share with them the increasing prosperity of the industry. At the same time the situation does present an extremely favorable opportunity for the study and introduction of new methods for making the same amount of effort more effective. We all know the difficulties encountered in asking an old experienced miner to change his way of doing something, but with the added incentive of more money these changes can be made much more readily. It is useless to expect a man to judge of the company's feelings toward him except in the light of his treatment at the hands of his immediate superiors, and this responsibility of the shift-boss to represent the company to the men both wisely and well, is, after all, the most important duty to them both. It has been said that justice is man's most important mission on earth. Now, unless a boss thoroughly understands the interplay of the forces set in motion by his orders, he cannot hope to estimate their results justly and distribute praise and blame where they belong. In addition to this there can be no co-operation that is not founded on mutual respect, and blackguarding a man, while it may arouse fear and hate, can hardly be expected to arouse esteem and respect. Without the co-operation of his men a boss is as helpless as a new-born babe. In recognition of this fact, too much importance cannot be laid on upholding his authority and discipline over his men; that is to say, he should hold his men individually responsible for the orders issued to them and should be held personally responsible by his foreman for the execution of all orders issued to him; the foremen, in turn, being held personally responsible for all orders issued to them. This system of responsibility, excepting in cases of extreme emergency, should be adhered to firmly.

In concluding these remarks, I hope that each of you will realize the responsibility that rests upon you. If you consider everything carefully when giving orders, so as to make it clear to your men just what should be done and see that they have the proper tools with which to do it, then you have the right to expect a reasonable day's work. Of course, you may not always be right and you will make mistakes like anyone else, but you must remember that you have been selected by your superiors on account of your ability to transmit and interpret their orders and that in every order you give, regardless of whether it is right or wrong, the company will be back of you and is upholding your judgment, giving you the benefit of the doubt until you should prove yourself unworthy of their confidence. The responsibility for good discipline and the goodwill of the men to yourself and the company rests entirely upon your shoulders. It is, therefore, of the greatest importance that you try to interpret the policy of the company correctly and to use your best judgment in matters of discipline, presenting orders and expecting a fair day's work, so that you will hold the respect and confidence of your men. I am convinced that the foremen and bosses of this or any other mining organization constitute the best asset of the company they are serving, provided they treat the men under their charge fairly, justly, and humanely. What can be a better asset to our company than a force of clean, satisfied, well-paid men, who have the fullest confidence in the organization under whom they are working, and who in case of either hard times, or in times of labor stress or strain, know of a certainty that the official representatives of the company are ready and willing to give to each workingman a square deal.

CHILEAN NITRATE, the existence of which was first mentioned in 1809, is said to have been first exported in 1830. Only a few thousand tons per annum was exported for some years, but the amount gradually increased until, in 1879, at the time of the Chile-Peruvian war, when the exports amounted to about 300,000 tons. This nitrate was largely produced from the Province of Tarapacá, which, until then, had been Peruvian territory. By the terms of peace with Peru in 1884, this province, as well as Tacna, became Chilean territory. The Bolivian Province of Antofagasta was also acquired as a result of this war, and thus Chile, with the deposits in her own territory, acquired control of the whole supply of nitrate. At the present time, exports are approximately 3,000,000 metric tons per annum, having a value, at the point of embarkation, of about $50 per ton, or a total of $150,000,000. The nitrate industry, measured by its monetary value, is thus of great importance—Rogers and Van Wagenen, Bull. A. I. M. E.

High-Temperature Resistance Furnaces

By W. E. RUDER

*In 1911, Winne and Dantsizen described two forms of resistance furnaces using ductile molybdenum or tungsten as resistors. Since the discovery, in the research laboratory of the General Electric Co., of methods for producing these metals in ductile form, their use as resistance elements has grown to such an extent that they are now almost indispensable. These furnaces are used for alloy research, annealing, heat-treating, and practically all of the thermal processes requiring temperatures above 900°C. Various types of furnaces have been developed to meet other needs of laboratory work. A tubular furnace, wound with a metallic resistor, is the simplest type to construct, and almost every laboratory has such furnaces. The only essential difference between a furnace wound with platinum or a base metal and one wound with tungsten or molybdenum is that the coils of the latter must be heated in a neutral or reducing atmosphere. It has long been the custom in the G. E. laboratory to build resistance furnaces with a metallic casing from which the tube could be easily removed for re-winding. The heat-insulating material, usually calcined magnesia, alumina, silica, or silex, depending upon the nature of the resistor, is used in powdered form so that it can be removed and replaced readily. In order to adapt this method to tungsten or molybdenum windings, it was necessary to make the casing gas tight and to provide it with an inlet and outlet for the neutral or reducing gas. On account of its greater pliability in heavy sections, molybdenum is commonly used for the windings. Its melting point (about 2550°C.) allows for a sufficient range above the softening temperatures of available refractories to make it unnecessary to employ the higher-melting tungsten. This holds true when resistors are run at atmospheric pressures; if, however, it be desired to run at reduced pressure or in a vacuum, tungsten is used, because the high vapor-pressure of molybdenum renders it unsuitable, and because a much higher temperature is available. The resistance of tungsten at 25°C. is 5.0 microhms per centimetre cube, and its temperature coefficient of resistance is 0.0051 (0–170°C.). Molybdenum has a resistance of 4.3 microhms per centimetre cube at 25°C. with a temperature coefficient of 0.0050 (0–170°C.).

*Abstract: 'High-Temperature Resistance Furnaces with Ductile Molybdenum or Tungsten Resistors,' presented at New York meeting, A. I. M. E., February 1918.

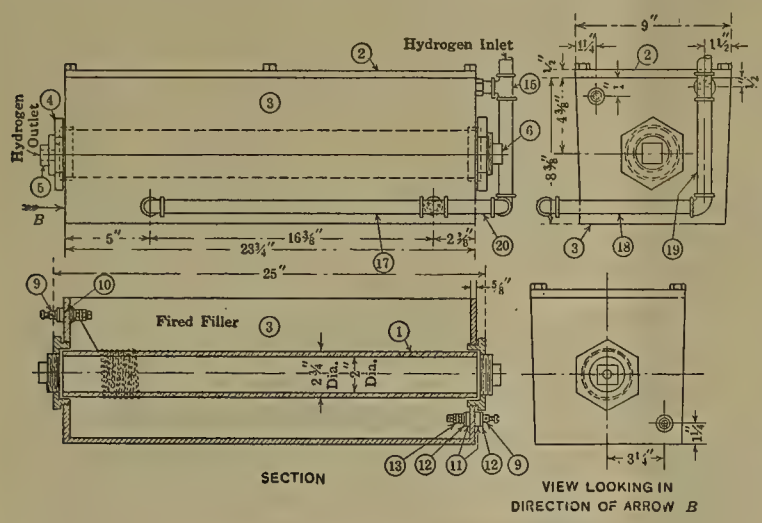


FIG. 1. HIGH-TEMPERATURE RESISTANCE FURNACE

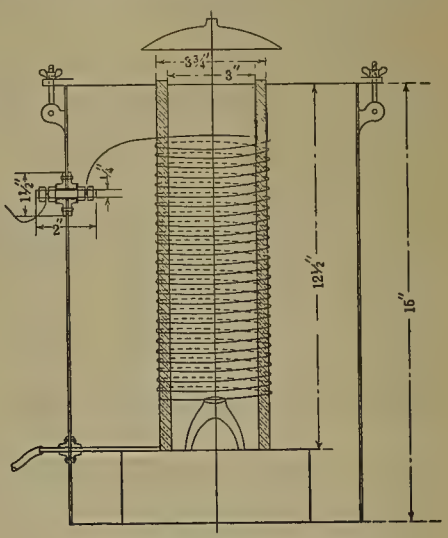


FIG. 2. VERTICAL TUBULAR FURNACE

The horizontal type of furnace in greatest use is shown in Fig. 1. The alundum tube (1) is fitted into the cast-iron box (3) provided with a lid (2) which is bolted on over an asbestos gasket. The flanges (4) are screwed in so as to make a good contact with the ends of the tube (1). Hydrogen is piped into the case through inlets (15–20), and escapes through the alundum tube and the outlet (5). No. 9–13 show details of the current-terminals. With this furnace, temperatures up to 1750°C. are readily obtained, but if a higher temperature is attempted the alundum tube begins to sag badly. Furnaces have been successfully maintained at higher tem-

peratures, but only with tubes of small diameter for the same thickness of wall. With one of these molybdenum-wound furnaces a temperature of 1700°C. may be attained in about 2 hours, but, for safety, about 3 hours is usually allowed.

It is often necessary to construct furnaces of larger size; these have been equally successful, but not for such extreme temperatures. For maintaining a temperature of 1750 – 1760°C., with a 36-in. alundum tube, 3 in diam. inside, wound with 128 turns of 0.05-in. molybdenum wire, four turns per inch, insulated with 4-in. alumina, this furnace required a total of 5920 watts or 5920÷301.6 = 19.6 watts per square inch of inside heating-surface. Horizontal furnaces of this diameter do not last long at this high temperature, but if the temperature is kept below 1600°C., a long life is possible.

Another useful form is the vertical crucible furnace. This type has been built in many different sizes. The heating tube varies from 1¾ to 6 in. inside diameter. Fig. 2 shows the construction. The alundum tube is 12½ in. long by 3 in. inside diameter, with ¾-in. walls; wound with 26 turns molybdenum wire, 0.067 in. diam., 3 turns per inch, and insulated with alumina, 3¼ in. thick. The total heating area is 84 sq. in., the current used being 31.2 watts per square inch at 1565°C.

A molybdenum resistance wire, after having run at a high temperature for some time, crystallizes so that it loses much of its original ductility and can seldom be unwound without breaking. If it is not too much caked with the fused alumina-packing, it can be loosened and the whole slipped off and put on another tube.

Influence of Brine on Reinforced Concrete

Reinforced concrete is by far the most popular structural material in use today. It is employed for the foundations of stamp-mills, often for the buildings enclosing them, and for treatment-vats contained therein, while the flume that conveys the water for power is frequently made of this material; but concrete, like everything else, has its limitations. The oldest reinforced concrete structures were built less than 20 years ago, and what the best of them will be like 50 years hence is a matter of pure conjecture. It is known, however, that there are some purposes for which reinforced concrete is wholly unsuited, and particularly is this the case where it is subjected to the action of salt and brines. Sea-water gradually causes the disintegration of cement; although many massive concrete structures have withstood the action of sea-water for many years, and are likely to stand for many years to come. Still, the disintegration is slowly going on, and is generally supposed to be caused, during setting, by the action of the magnesium sulphate of the sea-water on the lime and aluminates of the cement, with the formation of calcium sulpho-aluminate, which crystallizes with a number of molecules of water. Commercially, in fact, outside of the laboratory, it is practically impossible to make a concrete wholly impervious to water, and when the water coming in contact with the concrete carries salts, such as sodium chloride, that have a corrosive action on iron, it conveys them to the reinforcing material, and the latter, instead of being a source of strength, then becomes a source of weakness, for, in corroding, the iron expands, first cracking and ultimately breaking away the surrounding concrete. H. J. M. Creighton* gives an account, illustrated by photographic reproductions, of a number of buildings of reinforced concrete that he has examined in different parts of the United States. In all of these buildings salt or brine was used to a considerable extent, for the curing of foods or for other purposes, and the solutions being spilled on the reinforced concrete floors invariably produced a markedly detrimental effect. In the early stages the under side of these floors developed cracks stained by iron oxides and chlorides. As the injury proceeds, these cracks, which follow the network of reinforcing material, enlarge, and ultimately wedge off portions of the concrete. In some of the worst cases cited the reinforcing material, which originally was ⅛ in. diam. swelled to ¼ in. while the core of iron-wire inside was only 1/25 in. diam. When concrete construction is carried out in winter in cold climates, salt is often added to the mixing-water to prevent freezing. Mr. Creighton examined a quantity of such work and found that, when subject to the influence of moisture, deterioration invariably resulted, but when kept dry no damage could be observed.

From his observations, Mr. Creighton draws the following conclusions: "1. All concrete which is not waterproofed in some way is somewhat porous to water and brine. 2. Brine readily softens the surface of concrete, and, therefore, more easily penetrates to the reinforcement, on which it exerts a disintegrating action that, owing to the attendant expansion, causes it to crack and split and, in some cases, to fall away from the reinforcement. 3. The more porous the concrete the more rapid the disintegration of the reinforcement through the action of brine. 4. Reinforced-concrete floors that come in contact with brine will gradually develop leaks. These will be followed by incrustations of discolored salts on the under side, when, later, iron-stained hair-cracks will develop, running parallel to the reinforcement. As the deterioration progresses, the cracks will widen and, owing to the great expansive force of the accumulating iron oxide, the concrete will be gradually pushed from the corroded reinforcement and ultimately fall."

From these observations it will be evident that where concrete comes in contact with water carrying salts in solution that corrode iron, reinforcement will ultimately be a source of weakness rather than strength. Thus, in flumes that are to carry some of the brackish waters of the West, reinforced concrete is likely to prove less permanent than plain concrete. Mr. Creighton's article raises the question whether it might not be more economical in the end to use some reinforcing material other than iron—monel metal, for instance.

*Journal of the Franklin Institute, November.

Metal-Corrosion in Float-Valves

By PAUL T. BRUHL

To decide on the material most suitable for the float of a float-valve regulating the flow of acid sludge, strips of galvanized iron, wrought iron, and copper were partly immersed in beakers containing the oil, and allowed to stand at the ordinary mill temperature. The following results were obtained:

CORROSION TESTS

	Time of contact, hr.	Loss in weight per sq. in. per hr., gm.	Remarks
Galvanized iron	65	0.0000291	Corrosion fairly uniform, except at oil-air zone, which was stained black.
" "	167	0.0000261	
" "	407	0.0000239	
Wrought "	43	0.0000440	Corrosion less uniform; brown and bluish-green stains on test-pieces.
" "	145	0.0000212	
" "	385	0.0000292	
Copper	48	0.0000517	Corrosion at oil-air zone relatively great. Immersed portion of test-piece darkened; strong local pitting.
"	151	0.0000273	
"	391	0.0000184	

The value 'per square inch per hour' was obtained by dividing the loss in weight in grammes by the number of test-hours, by the number of square inches of the test-piece immersed in the acid sludge. It is seen that the loss in weight is least in the case of copper, but as the copper is strongly corroded at the oil-air zone its usefulness for a float is impaired, and it cannot be regarded as satisfactory compared with galvanized iron, which is more uniformly if more rapidly attacked. In the case of the wrought iron an increase in the rate of corrosion is seen after about 150 hours; this increase coincided with the appearance of the stains, and may be attributed to secondary reactions. A metal corrodes in two stages; the first holding good when it is freshly immersed in the corroding liquid, when the velocity of attack indicates the true rate of corrosion; the second when the corrosion or oxidation products have been deposited or formed on the metal, when the rate of corrosion becomes a factor of secondary reactions. The conslusion arrived at, therefore, was that galvanized iron would prove most satisfactory for the purpose.

Movement of Gold and Silver Bullion

The movement of gold in 1917, while largely in favor of the United States, was by no means as decidely so as in 1916, as a result of various credits arranged for the financing of purchases here by our Allies. Much the greater part of the year's inflow came, as in 1915 and 1916, for the account of Great Britain and our other European allies in the War, either direct by steamer or from the depository of the Bank of England at Ottawa, passing into this country by way of Ogdensburg, New York. In the aggregate, Great Britain sent us 500 million dollars, or about 93% of the year's total influx, of which all but an insignificant amount came from or through Canada. Arrivals of gold from France were merely nominal, but from Australia they were 12 millions, South America 7 millions, and West Indies, Mexico, and other countries to the south, 19 millions. Collectively the inflow of the metal for the 12 months reached $537,854,374, against $685,990,234 in 1916, and $451,954,590 in 1915. Shipments of gold were also very extensive, reaching a total of $371,883,884, or more than 1½ fold those of 1914, which, up to that time, had been the largest ever reported for any one year in the history of the country. The outflow consisted of about 104 million dollars to Spain, 45 millions to South America, 156 millions to Japan, 16 millions to the West Indies, 11 millions to Canada, and 40 millions to Europe, India, and the East. The net import-balance for the year, at $165,970,490, compares with similar remainders of $530,197,307 and $420,528,672 respectively, in the two preceding years, and a net efflux of $165,228,415 in 1914.

The imports of silver in 1917 were of about the normal amount, with Mexico the chief contributor, but the exports showed a heavy gain, partly, of course, due to the enhanced value of the metal, with Great Britain and British India the largest absorbers. The net exports of silver were $30,790,044, against $38,331,748 the previous year. Bringing together the various balances, we have the subjoined comparative summary for a series of years:

YEARLY TRADE BALANCE

Excess of	1917	1916	1915	1914
Mdse. exp...	$3,273,789,699	$3,091,005,766	$1,776,074,152	$324,348,049
Silver exp...	30,790,044	38,331,748	19,114,930	25,643,873
Total	$3,304,579,743	$3,129,337,514	$1,795,189,082	$349,991,922
Gold imps...	165,970,490	530,197,307	420,528,672	165,228,415
Grand total.	$3,138,609,253	$2,599,140,207	$1,374,660,410	$515,220,337

With all items included, the net export-balance for 1917, it will be observed, reaches the stupendous aggregate of $3,138,609,253, or 539½ millions more than in 1916, and 1764 millions in excess of 1915. It must be noted in passing that our net gain in gold since July 1, 1914, a period of 42 months, reaches 1005 million dollars. —'Commercial and Financial Chronicle.'

Bank Credit and Bond Issues

There is something so plausible and insidious about the idea of financing the War by having the banks create new credit that the stern alternative of cutting down the use of credit for other purposes, and of curtailing all business but that which supports the War, has a poor chance of popular favor beside it. What is the objection to a pyramid of credit, based upon Government bonds, and consisting, first, of individual credit, second, of member-bank credit, and, finally, of reserve-bank credit, all backed by the taxing power and the power to issue money? What can be better than such a combination as this? Why not finance the War in this way?

The answer is that this pyramid of credit cannot add one day's work to the industrial resources of the country. The entire programme upon which the Government is proposing to spend about $20,000,000,000 this year is all a matter of day's work. In times of peace the labor of the country is employed in private operations. The production consists in part of necessaries for immediate consumption, in part of luxuries, and in part of additions to the productive equipment. Now comes the War, and the Government wants to take over a great portion of the working force, and also asks the people to turn into the Treasury money enough to pay it. The rational way of complying with this request would seem to be, first, to cut out the production of luxuries or non-essentials; second, to cut down the additions to permanent improvements and equipment, restricting them to such only as will aid in carrying on the War and the essential industries; third, to keep enough people employed upon necessaries to support the country and the army, and to put all the others on war work; fourth, to turn into the Treasury, through taxes and loans, the money which was previously paid to these people now released from private service to war work. Since we are no longer expending the money in the old way we can let the Government have the use of it. The account balances. The country has simply diverted purchasing power from one class of work to another.

The other way of meeting the Government's appeal for help is to say, as considerately as possible, and with all possible assurance of patriotism, that we are sure that, if allowed to continue our industries and occupations as usual, we will be able to do a great deal more for the Government than we possibly can if we are interfered with; therefore, we offer to co-operate in getting up this pyramid of credit, and challenge the world to show wherein this credit is defective or insufficient. We, as individuals, will give our notes to our bankers, the latter will lend us the credit with which to buy Government bonds, and we will deposit the bonds with our notes as collateral security; the bankers can re-discount these notes at the Federal reserve banks, and thus recoup themselves for the advances they have made; and, finally, the Federal reserve banks, on the strength of the Government bonds in their possession, and by virtue of the power to issue money, can furnish the currency to pay all bills.

The object of this elaborate scheme—this pyramid of credit—is to supply the Government with the means to go off and fight the War by itself, leaving us, the people, to go on with business as usual, undisturbed. The weakness in the scheme is that it does not provide the Government with army, navy, or equipment. These can be had only by taking men—labor—out of peace employments and placing them in the employ of the Government; but when this is done, they go off our private payrolls and upon the Government's payrolls, and if we will now pay into the Treasury what we formerly paid to them, or for the things they were making, there will be no need for a pyramid of credit.

There is a theory that this war task can be handled somehow by increased energy and out of resources heretofore in reserve; but the demands of the Government are very elastic; they amount to all it can get. The more men we can send to France the better, the more cannon we can put on the line the better, the more ships and aeroplanes and supplies we can send, the better. And finally the more people we can keep on the farms and send back to the farms, the better.—National City Bank Circular, February 1918.

ALUMINUM production has tripled in the last five years. The world output for 1912, and the present capacity of the different countries, is given as follows:

	1912, tons	Present capacity, tons
United States and Canada	26,300	75,000
France	13,000	20,000
Switzerland	10,000	20,000
United Kingdom	7,500	12,000
Norway	1,500	16,000
Italy	800	7,000
Total	59,000	150,000

The aluminum industry is busily engaged in preparation for the time after the War, as it is supposed that a rich field will then be opened up for the use of various alloys of aluminum. It is thought that aluminum will, in many instances, be used as a substitute for copper and tin plate.

GOLD PLACERS were recently reported to have been found at Nieble and Villarrasa, in the Province of Huelva, Spain. In ancient times important quantities of gold were obtained from the valley of the Rio Tinto by the Phoenicians, representing concentrations from the eroding outcrops of the copper deposits. It is interesting to note that those venturesome pioneers should have overlooked any sources of the precious metal, and that the deposits should have remained unknown until this late day, especially in a region that has been carefully studied by so many able engineers. The new discoveries are in gravel beds in the Sapo Arroyo, which drains into the Rio Tinto.



A MOUNTAIN OF OIL-SHALE IN EASTERN COLORADO

Mining in Colorado

By ARTHUR J. HOSKIN

An institution intimately linked with the mining and metallurgical successes of this State is the Colorado Scientific Society. For many years this was the premier technical organization of Colorado and its membership roll contains the names of practically every man who had a hand in upbuilding the mining industry of the State. Most of the faithful workers of the old régime have passed and, during recent years, interest in the society has waned somewhat, there being too few members able to devote the time and energy necessary in keeping such a society properly alive. Feeling that a change of some sort might be beneficial, the executive committee has decided that, in place of the customary monthly meetings, there will hereafter be held but four meetings during a year, two in the spring and two in the fall. Each meeting will be preceded by a dinner. Addresses will be made by persons of eminence and dates of meetings will be set to accommodate the engagements of the speakers. The committee plans also to return to a former practice of publishing all addresses in bulletin form. This year's officers are: Richard B. Moore, president; Lewis B. Skinner, first vice-president; Marmaduke B. Holt, second vice-president; Harry J. Wolf, secretary; John W. Richards, treasurer.

Another organization holding the interest of Colorado mining, chemical, and metallurgical men is the Teknik Club, which, a few years ago, succeeded the Western Association of Technical Chemists and Metallurgists. Its meetings are held monthly at the Shirley hotel, Denver, taking the form of dinners followed by papers from members. As a rule—and as originally intended—the papers and discussions are upon strictly technical topics selected by the speakers. Recently, however, the club has enjoyed innovations when members have chosen as their subjects such topics as 'The Oriental Problem,' handled by Mr. Davis, and 'The New Psychology,' by Mr. McFarlane. At the February meeting, Mr. Roach, of the Great Western Sugar Co., spoke in detail upon 'Beet Sugar Manufacture.'

Professional men insist that Colorado must become an 'oil' State. When we had about concluded that the State's possibilities had been exhausted in the oilfields of Florence and Boulder, there came the excitement in the neighboring States of Wyoming and Kansas, leading many Coloradans to wonder why we could not push our State into the 'game,' as it is called. But geologists able to diagnose conditions gave us little encouragement for drilling in eastern Colorado, the region that is geo-

graphically between the neighboring productive States and geologically like them. Prof. Victor Ziegler of the Colorado School of Mines is delivering a series of popular lectures on petroleum in the legislative chamber of the Capitol. We are being awakened to the potentialities of great beds of oil-shale in the western part of the State. A new industry for America seems about to start in the excavation and retorting of this shale. Numerous companies have secured holdings and are planning to erect mining and distillation plants as soon as the weather will permit. Dr. David T. Day of the U. S. Bureau of Mines spent a few days in Denver recently and made two addresses on our oil-shale. His first lecture, delivered at the Capitol, elicited so much discussion and so many inquiries that a questionnaire was hastily planned and held the following day in the Chamber of Commerce. At this unique meeting Dr. Day frankly answered to the best of his ability every question asked, irrespective of the effect his statements might have on individuals, promoters, companies, or inventors. In his own words, he "clipped a good deal out of many prospectuses," and the meeting had a most salutary effect upon this budding industry. At this writing, oil-shale enthusiasts are uneasy about threatened legislation at Washington, but the cool-headed ones maintain that the Government will not do anything to disturb locators *ex post facto*. Hastily called sessions of shale-men were held at DeBeque and Denver and delegates have gone to Washington to lobby for the Walsh-Pittman bill, which is satisfactory to Western oil-men, but is meeting opposition from the ultra-conservative forces.

An interesting mining suit has been concluded in Denver. William B. Milliken, mining engineer, was defendant in a suit for $190,000 brought by Henry E. Frederickson, who charged fraud in connection with the sale of the Linda Ventura mine in Nicaragua. The trial occupied several days and brought out many charges and counter-charges. One point insisted upon by the plaintiff was that he lost his health by a trip to the property. Milliken maintained that he had forewarned Frederickson against the malarial conditions in Nicaragua and that the plaintiff, instead of providing himself with proper medicines, had relied upon his faith in a certain religious cult to resist disease. The suit was won by Milliken.

A bed of sulphur ore 7½ ft. thick, close to the surface of the ground, was located near Delta this winter. A short time ago, a well, being drilled near Delta for oil, turned into a geyser spouting sulphurous hot water.

The Primos Chemical Co. has its 250-ton mill at Camp Urad in Clear Creek county nearly completed. Mining men have been amused at an item in the daily press to the effect that a prominent sugar company is considering the erection of a sugar plant at Idaho Springs. Is this mountainous county to turn from mining to agriculture? The proposal is on a par with the ideas of the people of Leadville, a year ago, that they could secure a Government aviation school.

The Cresson mine has been again used to furnish spectacular news. This time the statement is made that new development on the 10th level has added upward of a half million dollars worth of $150 ore.

The Degge-Clark Tungsten Mining, Milling & Refining Co. has been reorganized as the Caribou Metals Co. It will hereafter own and operate not only the proved tungsten mines and mill in the Nederland district, but a well-known group of silver mines at Caribou.

At the annual meeting of the Golden Cycle Mining & Reduction Co. the following directors were elected: A. E. Carlton, H. McGarry, Richard Roelofs, L. G. Carlton, E. P. Shove, Spencer Penrose, Irving T. Snyder.

Some persons entertained a notion that the annual meeting of the Vindicator Consolidated Gold Mining Co. would be wildly exciting because, a year ago, disgruntled stockholders started a little tempest and it was presumed that they might come to this year's meeting sufficiently fortified to wield influence in the election of directors. However, it seems that diplomacy was utilized in healing the wounds and the old directors were reelected without a dissenting vote. They are Guilford S. Wood, A. E. Carlton, George A. Stahl, Adolph F. Zang, Irving T. Snyder, Philip A. Zang, and Charles Siegel Jr. The announcement was made that the flotation-mill is a success financially and will soon be treating 1000 tons daily.

POTASH and soda feldspars are mined near Kingston, Ontario, the former containing 10 to 12% of potash and the latter as high as 10% of soda. Prevailing prices are from $4 to $4.50 per net ton f.o.b. Canadian shipping point. The best time to purchase feldspar is in the winter season, as shorter hauls can be made then over frozen streams and marshes. There are two large grinding plants near Rochester, New York, importing feldspar from the Kingston district. The crude stone pays no duty on entering the United States while the ground spar pays a duty of 20%, therefore the grinding plants are in the United States. The value of feldspar exported from the Kingston district to the United States in 1917 amounted to more than $100,000; this year's contracts will exceed $300,000.

THE 'KIMURA TERM' is the title given by geo-physicists to a variation in latitude, discovered several years ago by a Japanese of that name, since confirmed by scientific men throughout the world. It consists in an effect similar to that which would result from an annual wandering of the centre of gravity of the earth to and fro along its axis, equivalent to a variation in the position of the centre of gravity of about three metres.

LEUCITE crystallizes in the lavas from Vesuvius, and the amount present is so large that the total potash content of these lavas often exceeds 7.5%. The formula is $KAl(SiO_3)_2$, representing 21.5% of K_2O. Leucite is characteristic of many modern lavas, and it forms mountain masses at the Leucite hills, Green River basin, Wyoming, which are as rich in potash as the Vesuvian lavas.



NEW YORK

General Situation Better.—Stock Market.—Detinning Process.—Mining Methods in New York City.—A. I. M. E. Meeting.—Coal Used in Lighting Cities.

Warmer weather has improved the general situation, and optimism prevailed when 'workless Mondays' were officially discontinued. Effect of the coal shortage is still being felt, especially at Newark, where many factories were shut-down during the past week and a great number of men were idle. Discontinuance of the fuel order is generally considered due to the fact that its enforcement was found impracticable, rather than that the results desired had been achieved. A salutary effect is already seen. Preventive measures against future disorganization are now well under way. New York City and New Jersey are to be connected by a tunnel for vehicular traffic. This will minimize the danger of a coal famine due to difficulties in water transport during severe weather. An ice-controller has been appointed with authority to cut up to 2,000,000 tons of extra ice from the Hudson and Mohawk rivers—a provision that will eliminate the fear of an ice famine in the summer and at the same time will save an immense amount of ammonia for war purposes.

Securities showed average net gains for the week. Even Liberty Bonds, after reaching a new low level, rallied and indicated a firmness in marked contrast to previous sagging tendencies. Peace and War news has been so intermingled that a neutralization of opinion has resulted; and market appreciations cannot well be ascribed to any well-grounded optimism. New import and export restrictions are not expected to be enforced in so drastic a manner that foreign trade will be crippled, or even seriously hampered. Experience with the fuel order has showed that exemption claims are successful in a great many instances, even when presented from unexpected quarters.

A new company, to be known as the Metal & Thermit Corporation, will result from the amalgamation of the Goldschmidt Detinning Co. and the Goldschmidt Thermit Co. The re-organized corporation will have a capital of $3,250,000, and will control the operation of the plant at Jersey City for thermit products, and other plants at Pittsburgh, San Francisco, and Toronto. Perhaps the most interesting feature of its operations is in connection with the detinning works at Chrome, New Jersey, and East Chicago, which handle over 100,000 tons yearly of tin scrap and chippings and produce therefrom about 2000 tons of tin. Two processes are in use: One, in which chlorine, manufactured at the company's Wyandotte plant in Michigan, is introduced under pressure into containers packed with the scrap. Destruction of the iron is avoided by the entire exclusion of moisture, and the prevention of rise in temperature. The product is an anhydrous tetrachloride of tin. In the alternative process, a mixture of tin chippings is boiled with sodium alkali and saltpetre, by which stannate of soda is formed. Oxide of tin is ultimately precipitated by dissolving the crystals in water and by treating the solution with carbonate of soda. The oxide product may be smelted to produce a high grade of metallic tin, or may be used as a pigment in enamel work.

The complicated ramification of underground railroads connecting lower Manhattan (the island on which New York stands) with Brooklyn and extending to other suburbs, is making steady progress toward completion. The extent of the work is such that it is difficult to generalize successfully without involving fundamental details, and these are of so varied a character that space forbids. Several features, however, are worth mentioning. The dual subway system calls for two 4-track trunk-line subways to connect lower Manhattan with Brooklyn and four tunnels where necessary underneath the East river. The cost of this section was estimated at $17,000,000, and this included five miles of shield-tunneling work. The Whitehall-Montague Street tunnel was holed through late in June last, after a record of 95 ft. 4 in. had been made in 6 days. The Brooklyn approaches are in some cases almost finished, and the work presented many interesting problems for the engineers. In one place, and for over a mile, the tunnels are lined with cast-iron and subsequently packed with sand and gravel delivered by compressed air. The ground through which the tunnels have been driven in Brooklyn is, for the most part, very loose, consisting mainly of sand, gravel, and boulders. Little trouble has been experienced from groundwater, although excavations were carried out in most instances below normal high-water mark. This was attributed to the fact that the locality is well drained by wells. In one instance a low water-pressure was encountered, and compressed air was used to keep the concrete in place until set, the blow-holes formed being subsequently plugged with a rich cement mixture. A feature of the work was the necessity for underpinning existing structures so that no surface settlement would take place as the work proceeded. At one part of Fulton street, Brooklyn, there will be four separate levels of subway trains and one elevated railroad structure; and it was necessary to carry out the tunneling directly under two existing subway tunnels and the elevated railroad structure, all carrying frequent trains, heavy street-car traffic, and lofty buildings. All the supports of the elevated railroad were underpinned in front and behind the shields as progress was made. As some of the buildings were 11 stories high, problems of tunneling through a loose soil underneath were fully appreciated in advance, and it was considered necessary in some cases to carry supporting walls to sub-grade. In other cases where the load was less, walls were supported by screw-jacks. Greater part of the work is carried out by shields that are pushed forward and form the support for the concrete which is allowed to set as the material in the space beneath is being excavated. Concrete is delivered through long pipes to the face, being forced through these by compressed air from a sort of monteju or cylinder. These pipes are quickly worn through, and this is a serious but apparently unavoidable factor of expense. The shield may weigh as much as 60 tons for large tunnel work, and in this case is pushed forward by means of 14 or more 110-ton hydraulic jacks operating with a pressure of 5000 lb. per sq. in. In certain parts, timbering methods have been adopted, but the work is slow and cumbersome compared with shield-tunneling, and calls for much lumber. Some of this is lost, as it cannot be recovered after the concrete is set. Phraseology of subway timbering is strange to the miner, who finds difficulty in understanding the origin of such terms as 'needles'

and 'whales'. Subway labor is recruited mainly from the foreign element, and men with a knowledge of timbering are in demand.

The 116th meeting of the American Institute of Mining Engineers opened here on February 18, when about 150 members and guests registered for the convention. The morning was taken up with sessions on coal and non-ferrous metallurgy, and consideration of six interesting papers. Vice-president Ludlow of the Lehigh Coal & Navigation Co. made some pertinent statements anent the coal situation. Anthracite production, he averred, has reached maximum production, and the possibility of discovering further deposits in the United States was remote. George S. Rice, of the U. S. Bureau of Mines, contended that a proportion of the recent trouble was due to individual apathy on the part of some of the miners, and that the high rate of wages now being paid tended to encourage frequent absences from work, and for no other reason. A visit to subway workings in Manhattan and Brooklyn was arranged for the afternoon, and the ladies were the guests of W. A. Clark and H. C. Frick at their Fifth Avenue residences.

Interesting figures dealing with artificial illumination were given by P. S. Millar at a meeting of the Illuminating Engineering Society of New York during the week. The speaker contended that artificial standards of illumination were too low before the War, and that much more efficient output could be obtained in certain industries by increasing artificial lighting. With regard to the question of the economy of coal by decreased lighting Mr. Millar pointed out that any practicable reduction would only effect an inappreciable saving of coal. The total amount of coal used in this country for lighting purposes was given as 12,000,000 tons per annum.

CRIPPLE CREEK, COLORADO

VINDICATOR CONSOLIDATED RESERVES.—SALE OF ORE-DUMPS.—IRONCLAD HILL MINES.—LEASED MINES' ACTIVITIES.

Annual meeting of the Vindicator Consolidated Gold Mining Co., held at Denver on February 14, resulted in re-election of former directors and officers, as follows: president, G. S. Wood; vice-president and general manager, Irving T. Snyder; treasurer, Adolph F. Zang; and secretary, George A. Stahl; who with A. E. Carlton, Philip A. Zang, and Charles Siegel Jr., complete the board. Report of Louis S. Noble, consulting engineer, stated that company ore production in 1917 was derived almost entirely from previously opened reserves, which have been depleted accordingly. Measurable ore blocked out amounts to 255,000 tons, 114,370 tons of which is broken and 141,210 tons is in place. In addition, there is a large area of caved stopes in the upper portion of the Golden Cycle shaft, from which a substantial tonnage can be drawn which should yield a good profit by the present washing and milling system. About 100 tons daily has been drawn recently from this source, with satisfactory results; and although definite measurement cannot be made, it is certain that a considerable rate of production can be maintained for a long time.

Dumps on the Stratton estate have been sold outright for immediate removal, and most of the ore will be treated at the Golden Cycle and Portland mills. These dumps are the Abe Lincoln, Poverty gulch; Keener tunnel on Globe hill; Half Moon and Geneva, Gold hill; Temomj, Gold hill; and Hidden Treasure, Lottie, Pikes Peak, and Garfield Grouse, on Bull hill. It is understood that the Stratton estate is to receive 75c. per ton for all rock moved. Henry Von Phul, former sheriff of Teller county, has commenced moving the Keener Tunnel dump to the Independence mill of the Portland company.

Edwin Gaylord, lessee at the Forest Queen on Ironclad hill, has commenced shipping from new orebodies opened on the 650 and 750-ft. levels. Returns from a car of screenings from the deeper levels were settled for by the Golden Cycle company at over 3 oz. gold per ton.

Production started on February 23 from the Pride of Cripple Creek, another Ironclad hill property, operated by Cox, Beebe & Co., lessees. Ore mined at the 600-ft. level is estimated to carry 2 oz. gold per ton.

Track is being laid into the Index mine on Gold hill, and with the loading-switch in readiness for cars, the El Paso Extension Corporation will commence shipping. Three sets of lessees are mining ore on No. 2, 3, and 4 levels, and the company is mining better than 2-oz. ore from the bottom of the winze sunk 150 ft. from the bottom, or 900-ft. level. The property owned by the Index Consolidated Mining Co. is under bond to the present operating company, of which A. J. Campbell is superintendent.

Casson and Fink, of Victor and Canon City, have opened a new and strong body of milling ore at a depth of 100 ft. on Block 3 of the Ajax, on Battle mountain. The trial shipment sent out this week is estimated at $30 per ton.

The Victor Gold Mining Co., operating the Prince Albert group on Beacon hill, under lease and bond to purchase, shipped 1-oz. ore last week.

SUTTER CREEK, CALIFORNIA

FREMONT SHAFT-SINKING.—SALE OF HARDENBURG MINE.—SOUTH EUREKA.

Two months work completed sinking the Fremont shaft 200 ft. to the 2950-ft. level, and station cutting is now under way. This is considered excellent progress. Several miles of driving and cross-cutting have been done from the Fremont and Gover shafts during operation of the combined properties, the Gover shaft having a depth of 1500 ft. and being connected with that of the Fremont. Oil is used for fuel for the steam hoists at both shafts, and the 40-stamp mill is operating steadily. The vein from which the property has been successfully worked for many years is about 6 ft. wide. About 200 men are employed.

A trustee's sale of the Hardenburg mine, south of Jackson, took place at the court-house this week. John Dohmann purchased the property for $10,000, but it is understood about a quarter of this amount will be refunded to cover the title to mill-site, the mill having been constructed on ground other than that owned by the company. This means that the proceeds of the sale will net the creditors only about 18% of their claims. The Hardenburg Mining Co. of San Francisco purchased the property about five years ago and spent considerable money on development, including shaft-sinking. While indications seemed good for pay ore, the equipment proved inadequate for handling the water and extracting the ore at a profit, so operations discontinued. A company headed by W. J. Loring worked it under option for a short time since, but the purchase was not consummated. Creditors of the Hardenburg company assigned their claim for material and supplies to C. L. Culbert, as trustee, and the sale was made for their benefit.

Prospects appear brighter for the South Eureka mine, as a number of the men who were recently laid-off have resumed work in the shaft, and preparations for sinking are now under way. It is stated that this change of plan is due to the faith of the management in the property and the fact that conditions in the adjoining Central Eureka mine in depth are so good. H. Malloch is general manager, and W. H. Schmal, superintendent, of this property, which employs about 300 men when the entire plant, including the Oneida property, is in operation.

WASHINGTON.—The Sierra Asbestos Co. has been authorized by the State Corporation Commission to issue shares, etc., to purchase and operate unpatented mining claims in this district.

PLATTEVILLE, WISCONSIN

EFFECT OF PRICE-FIXING ON ZINC ORE.—LEAD ORE AND SULPHURIC ACID.

Government price of 12c. per pound on high-grade spelter evidently had an effect on the ore situation in this region, as demand for such metal stimulated demand for high-grade ore.

The Mineral Point Zinc Co., with smelters at DePue, Illinois, also mines and concentrators in the Wisconsin field, produces high-grade metal, but recent unfavorable conditions curtailed the output.

While the Government price for high-grade metal helps some, an official of the American Zinc & Lead Smelting Co. states that no demand has been set up for prime Western, and there is now about 60,000 tons of this grade in stock. There is nothing, therefore, in the metal situation to warrant higher prices for zinc ore, but the situation locally has benefited zinc refiners, who were given advances of $2.50 per ton on top grades of blende at $62.50 per ton base, with an increase of $5 per ton on second and medium grades. This situation is likely to prevail for some time at least, and ore production is being encouraged, especially with the larger operating groups affiliated with the zinc-ore refineries. The demand for the lower-grade ores has not been improved through these developments, and much concentrate is in stock at nearly all points in the field.

Lead-ore producers are involved in a complex situation, not readily understood by the layman. Large sales of ore have not been made for five months, during which time production has been above average. Offerings of $85 per ton have been submitted, which gives a fair profit to producers, most of whom recover lead as a by-product through wet concentration of zinc ore; but sellers show no disposition to part with their product, and it remains to be seen whether they have exercised prudence in holding so long. Buying representatives are restricted in this field to practically one smelter—the Federal Lead Co. The New Jersey Zinc Co. has recently been in the field for lead ore, but succeeds only so far in obtaining the product of its own mines.

Firm offerings on lead ore give prospectors encouragement to re-open many old workings. In the Galena district at West Diggings several small companies have opened ore in new ground, especially on the Spillane farm. At a depth of 90 ft. three prospectors are mining 10 tons of 85% ore daily.

Demand for sulphuric acid has been strengthened by Government investigation of available supplies, and prices for pyrite have shown improvement for the first time in two years, open market sellers taking advantage with increased deliveries. Car shortage has retarded deliveries of February, and a large reserve is on hand, which owners are more than anxious to dispose of, as there is little pyrite coming direct from mines, and the fines held at separating-plants are felt to be an encumbrance on current production. Mineral Point Zinc Co. ships one 25-ton tank-car nearly every day. Most of this is delivered to the U. S. Steel Corporation, Pittsburgh. Large quantities of low-grade Western blende and high-grade Mexican carbonate ores are received at the zinc-oxide works of the company at Mineral Point, where the plant is running day and night.

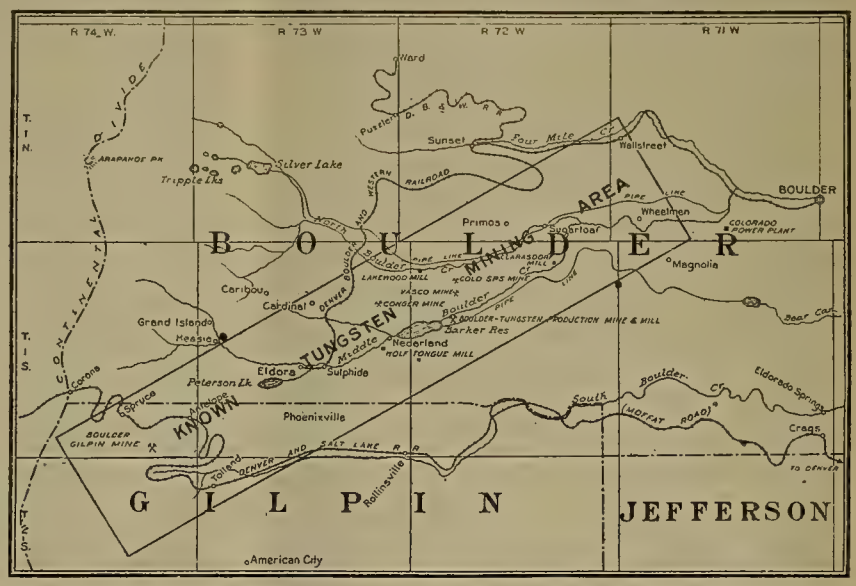
Shipments of zinc oxide in car lots have been given increased impetus recently, and a large force of coopers and bag-makers is now employed. Thousands of tons of coal-screenings are used in mixing the charges for the two blocks of double 10 furnaces, and during the coal shortage no shutdown was necessary on account of foresight of the management. The labor situation at Mineral Point Zinc Co.'s plants has been good all winter, mainly through employment of foreigners, many of whom are Italians.

NEDERLAND, COLORADO

MINES IN THE CARIBOU DISTRICT.

Mining outlook for Boulder county this coming season is good.

Caribou district will be the scene of a boom this spring. During winter high-grade silver-lead ore has been shipped in carload lots. Deep snow and lack of labor and transportation facilities have retarded prospecting and mining. High prices for silver resulted in re-opening old mines, and every lease was in demand. A fine development in the Conger Chief added impetus to operations.



MINING DISTRICTS OF BOULDER COUNTY, COLORADO

Johnson and Johnson, above the Potosi, are doing likewise.

Comstock mine of Hankins & Co. is shipping three carloads per week of 1100 and 1600-oz. silver ore.

Snow—10 ft.—is hindering work at the Conger Extension of Russell and McSherry.

The Croesus claims in Hicks gulch, between Cardinal and Caribou, were recently located by Judge T. H. Thomas of Nederland.

A. B. Clarkson of St. Louis will do extensive work this year on claims adjoining the St. Louis and Boulder County Mines' tunnel.

Wolf-Tongue lessees are officially reported as doing well at tungsten mining, especially Nels. G. Olsen, who is working on a large deposit in the Cross mine, at Cold Springs. Company's concentrating mill is operating to capacity.

Conditions at Cottonwood were never better.

Nederland is also busy, and Beaver Creek.

Huron mine at Eldora is yielding high-grade gold ore, which is being held until the mill is completed.

TONOPAH, NEVADA

SUMMARY OF PROGRESS IN THE IMPORTANT MINES.

The Tonopah Mining Co. in January treated 15,500 tons of ore giving a net profit of $56,340. Metal production was 1606 oz. gold and 146,477 oz. silver. At the Silver Top, 17 ft. of development has been done, 22 ft. at the Mizpah, and 52 ft. at the Sandgrass. On the 500-ft. level of the Mizpah shaft a raise has been started to prospect an undeveloped block of ground. On the 1300-ft. level of the Sandgrass the north cross-cut on the west drift made good progress without any change. Production last week was 3200 tons.

At the Victor shaft of the Tonopah Extension Mining Co. 156 ft. of work was done and 60 ft. at No. 2 shaft. At the latter, raise No. 641 on the 600-ft. level, made a connection with the level above. On the 1350-ft. level raise No. 572 advanced 11 ft. on a 4-ft. face of ore. At the Victor, on the 1440-ft. level, east drift No. 604 shows a 5-ft. face of ore. The intermediate east drift from winze No. 1501 on the 1540-ft. on the Murray vein advanced 24 ft. in ore. A raise will be started from the 1680-ft. level to make a connection with the intermediate drift. On the 1680-ft. level, work has been suspended on the O. K. and Victor veins until a connection by the west cross-cut from the Merger vein is made with the Cash Boy. Stoping has been started on the Merger vein showing 6 to 8 ft. of ore. The south cross-cut advanced 58 ft. toward the downward extension of the Murray vein. Production last week was 2380 tons.

The Tonopah Belmont Development Co. treated 10,357 tons of ore in January giving a profit of $60,138. Metal production was 1270 oz. gold and 124,291 oz. silver. On the 800-ft. level east drift No. 8019 on the Occidental vein cut a fault, and a south-east cross-cut has been started to pick up the faulted segment. South cross-cut No. 8006 is being driven to cut the extension of the South vein on this level. Raise No. 20 on the South vein shows a 5-ft. face of good ore. On the 1000-ft. level east drift No. 1087 on the Favorite vein shows a decrease in the width of the vein, which is low-grade ore. On the 1100-ft. level east drift No. 1161 cut a branch of the Mizpah Fault vein showing medium-grade ore. On the 1400-ft. level north of the cross-cut No. 9 is following a small branch of the Shaft vein, which is a good grade of ore. Last week's production was 2256 tons.

At the Ohio shaft of the West End Consolidated Mining Co. intermediate No. 528 is being driven for a connection with raise No. 513 for mining purposes. Winze No. 534 made good progress in ore and drift No. 539 continues in low-grade ore. On the 555-ft. level No. 7 raise reached the hanging wall of the vein, exposing good ore. No. 3 and 5 cross-cuts are being extended, and new raises to the vein will be started at intervals. Cross-cut No. 601 is in the foot-wall of the vein, and is being driven for a connection with winze No. 534. When this is made, regular development will be started on this level. At the West End shaft, west cross-cut No. 809 is making slow progress in low-grade ore. The output last week was 1118 tons.

At the Halifax Tonopah cross-cut No. 1018 is making good progress, and drift No. 1019 continues on a stringer of high-grade ore. A new cross-cut has been started on the 1100-ft. level to cut the downward extension of the high-grade stringer. On the 1200-ft. level cross-cut No. 1256 has been discontinued, and cross-cut No. 1258 started.

The Jim Butler Tonopah Mining Co. in January treated 1893 tons of ore, giving a profit of $3010.. This is much lower than usual, due to repairs. At the Desert Queen shaft west drift No. 5 on the intermediate level between the 500 and 600-ft. levels shows a 4-ft. face of ore on the South vein. At the Wandering Boy shaft raise No. 376 on the Wandering Boy vein shows a 4-ft. face of medium-grade ore. On the 6th level east drift No. 630 is making good progress on the Wandering Boy vein on low-grade ore. The output last week was 433 tons.

Cash Boy has advanced the west drift on the 1600-ft. level 40 ft. The face is in high-grade ore, and the width of the vein averages about 5 ft. Production last week was 55 tons, shipped to the Western Ore Purchasing Company.

The north cross-cut on the 700-ft. level of the MacNamara mine is making good progress. A raise has been started from the 600-ft. level to prospect the rhyolite-trachyte contact. The output last week was 538 tons.

The Montana produced nothing and miscellaneous 66 tons, making the week's production at Tonopah 10,137 tons having a gross value of $172,329.

TORONTO, ONTARIO

LABOR.—HOLLINGER IN 1917.—DOME DEVELOPMENT.—ANKERITE, NORTH THOMPSON, AND ELLIOT-KIRKLAND.—TEMISKAMING AFFAIRS.—GOWGANDA FIELD.

The labor situation at Porcupine is better and prospects of increased production during the coming season are decidedly hopeful. Annual report of the Hollinger Consolidated is most encouraging. The total income for 1917 was $4,271,260, with a gross operating profit of $2,009,549. After deductions for depreciation, taxes, and donations, there remained a net profit of $1,720,314. The deficit of $269,590 was wiped out. Plant expenditure amounted to $673,237, and $131,224 was charged to capital development. The surplus on hand was $712,724. The most significant feature shown is the notable increase in ore-reserves. Although over 508,000 tons of ore was extracted, reserve value has increased from $34,185,535 to $40,231,435. The new ore has been nearly all developed above the 800-ft. level, the ground below that depth being unexplored and of great speculative value. The average value of reserves is estimated at $8.95, as against $8.68 per ton a year ago.

Operations at the Dome Mines are confined to deepening the main shaft and exploration, but the ore extraction will be resumed as soon as sufficient labor can be engaged.

At the Ankerite the downward extension of the orebody has been found on the 200-ft. level. The shaft is being sunk to 500 ft. where it is proposed to open extensively, to be carried into the Maidens McDonald adjoining, which is also owned by the Coniagas.

Grade of ore milled by the Vipond-North Thompson shows improvement, averaging $10 per ton.——Development work on the Thompson-Krist adjoining is to be carried on from the 400-ft. level of the Vipond.

Shaft at the Elliot-Kirkland is being sunk 500 ft. The vein, which was narrow at 100 ft., has widened at 300 ft. to 11 ft. of good grade.

At the Kirkland-Porphyry No. 1 shaft is down 300 ft., where the vein is 5 ft. wide, showing higher gold content.

The serious disagreement among the Temiskaming shareholders developed in the course of a hot campaign waged by the interests represented by Max Morgenstern of New York, against the management, was brought to a close at the annual meeting on February 5, when the old directors were ousted and a new board elected. J. P. Bickell, of Toronto, was chosen president, and W. J. Sheppard, of Wabaushene, Ontario, vice-president. The new president made it clear that he did not in any way represent the Morgenstern faction, and the election was made unanimous. The board fixed the salary of the president at $7500 and that of the vice-president at $1000.

At the Beaver, a winze being sunk from 700 ft. to the 800-ft. has cut high-grade ore.

The Trethewey is actively pushing work on the Castle property in the Gowganda district. Large buildings are being erected, and preparations are being made to bring in machinery, which must be hauled 25 miles from the end of the railway.



ARIZONA

BISBEE.—Shattuck-Arizona Copper Co. reports that for 1917 net profits totaled $1,477,500, against $3,074,013 in 1916, and $1,174,027 in 1915. Dividends last year amounted to $612,000, compared with $1,662,500, and $875,000. Surplus at end of 1917 was $2,375,397, an increase of $100,000.

GLOBE.—Iron Cap company announces that the orebody recently opened on 10th level is 50 to 55 ft. wide. Ore is estimated to average 6% copper, but in streaks is as high as 35%. Company is now driving both east and west on the vein. Last month shipments totaled 138 carloads, a new record. Sinking has been resumed on the Williams shaft, 20 ft. having been sunk from the 1100-ft. level.

Owing to a blow-out in an air-pipe to a hoist at the Williams shaft of Iron Cap mine, four men could not be taken out, and were killed by a charge that had just been lighted.

Profitable ore has been opened on the 1500-ft. level of the Arizona Commercial.

JEROME.—Jerome Verde Copper Co.'s Columbia shaft was down 1100 ft. at end of 1917, and 1859 ft. of drifts and 1342 ft. of diamond-drilling done. From the north-west workings—900 ft. deep—1610 tons of 8.55% ore was extracted, and the north-east workings are down 1100 ft. Orebody is 40 ft. long and from 6 to 20 ft. wide. Probably several thousand tons are available above 900 ft. Ore was mined under agreement with United Verde Extension, which terminated on December 1.

Potash is reported to have been discovered near Walnut Springs, 3½ miles from Jerome, by Tom Smart. The U. S. Bureau of Mines has been asked to investigate.

KINGMAN.—Cross-cut being driven west from the 250-ft. level of the Leviathan mine toward the Copper Wonder picked up a new vein 15 ft. from the station. This vein is 2 ft. wide, is high in molybdenite, and is similar in character to the main orebody. A pump is being lowered in No. 3 shaft of the Copper Wonder to secure increased water supply for the mill.

In the Aquarius mountains, the old Shipp mine, famous as a silver producer, has been re-located by Sitton and Murphy, who assert that the vein is rich in copper.

After developing large quantities of shipping ore on the Golconda Extension, Walter H. Brown and associates will now arrange for a new milling plant.

Arrangements have been completed to develop the Standard Mineral Co.'s mine, formerly the Telluride Chief. A gas engine, compressor, pumps, and machine-drills have been ordered. There is about 2000 tons of ore on the dump. The company contemplates the erection of a 100-ton mill as soon as development is well under way.

NOGALES.—The Lower California Metals Co., a sub-company of the Sociedad Anonima de Metales, whose headquarters are in Mexico City, is operating here. The former company holds all the property in the United States, and acts as agent for the business affairs of the Sociedad Anonima, which have to be conducted in this country. At Nogales the company owns a 100-ton flotation mill of the latest type that has been erected for the treatment of ore coming from the mines of the Sociedad Anonima in north-western Mexico. The Lower California company also buys molybdenite ores in the United States for treatment at its plant.

OATMAN.—The Goldroad Bonanza company states that on the 550-ft. level the vein has been followed 125 ft. in milling ore, the last assays being $14 per ton across 5 ft. No. 2 assessment of ½c. per share has been levied to pay for mining, erection of bins, etc., until treatment is commenced on April 1.

United Eastern Mining Co. in January produced 8100 tons of $22.85 ore, a record. Recovery was 96.82%. On February 20 the 965-ft. level cross-cut reached the vein, where it is similar to the upper levels. War taxes for this company in 1918 will be about $125,000.

Tom Reed company, cross-cutting from Aztec 500-ft. level, has opened 65 ft. of ore, 400 ft. south of Aztec. Only 12 ft. is profitable; 65 ft. assaying $8; 5 ft., $40; and 8 in., $400 per ton.

PRESCOTT.—Old Dos Oris mine, with the Buzzard and Raven, 14 miles from Prescott, have been taken over by J. B. Tomlinson, representing an Eastern syndicate. They were owned by R. H. Burmister. In 1885 they suspended operations, due mainly to troubles in which litigation followed for years. Dos Oris was rated as the largest silver mine in Yavapai county, and with limited development in two years yielded $166,000, and during the operation of the Buzzard and Raven, some $30,000. Under new management, modern machinery will be installed.

RAY.—The Ray silver-lead mine, four miles by steep trail from this place, is shipping by mule-team a carload of ore daily. The property was located in 1878, and is known as the Haly-Suffern. A company headed by Captain William McDermott of Tucson now operates it. The carbonate ore assays 30% lead, with $12 in silver and gold. J. Pollard is in charge.

South-east of Ray, also on a steep mountain, is the Ray Broken Hill mine, where an outcrop carrying silver, lead, and gold, with some copper, is being developed. Frank Schilling is manager.

Ray Consolidated has sunk a new shaft at a point convenient to stoping ground, to be used solely by miners, who now are compelled to climb long stairs in inclines at the principal shafts, taking time and adding to their fatigue. The new shaft, 512 ft. deep, is to have a double-deck Otis elevator. An arched double-tracked tunnel, a third of a mile long, buttressing against solidly shifting ground, has been finished in concrete on the third level of No. 2 shaft. Ore drops into a 500-ton bin, from which the skips are loaded almost automatically. Safety first is noted, as not a wire or pipe is visible, all having been hidden in conduits. Another feature of the mine is the substitution of air for former electric hauling. The new machines are of the H. K. Porter type, taking up to 1000 lb. pressure. The electric system carried 440 volts and caused fatal accidents.

SALOME.—Rich Hill Gold Mining & Milling Co. has been organized to operate the Old Johnson mine.

Argus Copper property, adjoining the Planet in the Swansea district of northern Yuma county, has been taken over by E. C. Lane and associates. Active development will be started at once, all necessary machinery now being on the ground.

Rich gold ore 600 ft. east of the old glory-hole, which started the first Salome excitement, has been made.

A carload of 20% copper and $10 gold ore has just been shipped from the Vindicator mine of the Black Giant Mines Co. Vindicator shaft is down 80 ft., and shows 2 ft. of ore.

CALIFORNIA

Oil production of this State in January amounted to 292,860 bbl. daily, an increase of 14,000 bbl. over the December total. Stocks decreased 678,000 bbl. to 31,772,465 barrels.

ETNA.—I. J. Luce of Seattle, Washington, and John M. Tetherow of Grants Pass, Oregon, who recently acquired the Blue Jene gold mine of the Siskiyou Syndicate, near Etna, are erecting a stamp-mill and will be opening a large body of rich ore within 30 days.

FORBESTOWN.—Butte Consolidated Gold & Silver Quartz Co. has been organized at San Francisco, with G. H. Homer as president and H. C. Freeman as secretary, to operate 10 claims in this district. Company is now ready to start exploration. An office is to be opened at Oroville.

GAZELLE.—Dewey mine, 8 miles from this place in Siskiyou county, has recently had power connected and surface plant overhauled. A good deal of $5 to $30 oxide and sulphide ore has been opened, enough to supply the 10-stamp mill and three Wilfley tables for several years. Some rich sulphide is sent to the Mammoth smelter in Shasta county. G. C. Brown is manager and E. H. Page superintendent, and have done good work in bringing the mine to its present stage.

GRASS VALLEY.—Empire Mines Co. has started construction of a tailing-dam. Residue will be prevented from flowing into Wolf creek by a concrete dam. It is estimated that the canyon will store tailing for 30 years at present rate of milling. Sixty stamps are dropping steadily, and most of the ore is coming from below 4000 feet.

MAGALIA.—Mineral Slide Gold Mining Co. has permission from State Corporation Commission to sell 15,000 shares at 20c. each, for cash.

NEVADA CITY.—Under control of Morgan & Leichter, the Oustomah mill has been overhauled, concentrators and special equipment added, and is dressing chrome ore from the Sweet property at Lime Kiln. Eight motor-trucks are delivering the ore, which is said to be of good grade.

PLACERVILLE.—Teddy Bear and Hot Spur gold mines, near the old Church-Union mine, 7 miles south of Placerville, is being developed by W. W. Milner and others of Seattle. When sufficient ore is opened a 50-ton mill will be erected. In Teddy Bear claim an adit cuts vein at depth of 135 ft., and from this point a winze is to be sunk to 350 ft. Vein is 10 ft. wide.

PORTERVILLE.—Freight embargo has resulted in suspension of work at calcining plants of American Magnesite Co. and Porterville Magnesite Co. Plant of Tulare Mining Co., 12 miles east of here, continues operating, as its product is disposed of in the West. The American company owns no mines, but calcines ore from other properties.

Lindsay Mining Co., headed by R. D. Adams and K. G. Gillette, has sold its mines and works in the Success district, 12 miles east of Porterville, to the Tulare Mining Company.

Magnesite shipments from this point are reduced to one carload occasionally, compared with three to five daily some time ago.

SONORA.—Owners of the Densmore mine await early start of operations by the Salt Lake, Denver, and New York investors who recently acquired possession under bond and option. During several years in the earlier days of quartz mining, the Densmore was a good producer, and was once owned by Alvinza Hayward and associates, who paid $125,000 cash for it. Passing next into the hands of a local company, it was worked intermittently with indifferent results. It is situated 3 miles westerly from Columbia, and is equipped with a 10-stamp mill and other machinery.

Hope mine, just outside the eastern limits of Sonora, suspended operations indefinitely on February 1.

Sonora Wonder mine, sold lately to Frank Solinsky and E. M. Blake of San Francisco, has been examined for the owners by J. H. Morris. Two payments have been made, and the last is to be made shortly.

Rich ore has been opened in a 72-ft. shaft at a mine on the Jones ranch, near Shawmut. This is being developed by Francis Gage.

Activity in chrome mining in the western part of the county is steadily increasing; everywhere in the neighborhood of the chrome deposits prospectors are busy and locations are being made daily.

Work was commenced January 29 on the new adit that will open one of the rich ancient channels that traverse the property of the Springfield Tunnel & Development Co. The channel toward which the adit is being driven was prospected by means of a shaft, which had to be abandoned on account of excessive quantities of water. The portal of the adit is on the property of John Wight, which adjoins the company's holdings on the west. All rights necessary for carrying on work from the Wight place were recently secured by the mining company.

YREKA.—John Whitney is developing a chrome deposit near here and on an adjoining farm Mr. Irwin has shipped 25 tons of chrome, and will be a steady shipper. These two properties are reported to contain large deposits and high-grade ore.

Henry Wintering, superintendent for the Cliff, in the Yreka district, reports that much progress is being made in development and the mine will be a big producer in the near future.

COLORADO

BLACKHAWK.—Powers mine in Russell district is under lease to Robert Wilkinson and others of this place, who formed the Powers Mining, Milling & Leasing Co. An electric pump, air-compressor, and other machinery are to be ordered. This mine is said to be one of the best copper producers in Gilpin county.

Denver people have leased the Toronto silver mine in the Hughesville district, and will erect machinery. Stephen Hoskin is owner.

Silver Dollar mine in Russell district is to be re-opened by O. J. Duffield and others of Denver. Main shaft is to be sunk 100 ft. deeper.

BOULDER.—Owing to the high cost of supplies, the United States Gold Corporation, which is mining low-grade ore, is maintaining operations at a minimum, milling having been suspended.

BRECKENRIDGE.—Developments at the Royal Tiger mine, T. A. Brown superintendent, have been encouraging, and a mill is to be ordered at an early date.

CRIPPLE CREEK.—Roosevelt drainage-tunnel in January was extended 144 ft., and the Cresson cross-cut was advanced 105 ft. Face of tunnel is 60 ft. from Colorado City claim of Portland company.

Colburn mill is to resume treatment, employing a flotation method said to be patented by E. A. Colburn.

DENVER.—Crude oil from Rio Blanco County shale, distilled in Oklahoma, yielded 15% gasoline, 16% naphtha, benzine, and kerosene; 43% lubricating oil, and from 8 to 10% paraffin wax.

GEORGETOWN.—At the Colorado Central mine a 10 by 20-in. Blake crusher, two sets of 16 by 36-in. rolls, roughing jigs, Empire tables, trommels, etc., are being installed. Ore from the mine will be delivered from the Equator adit to the mill, which is to have ball-mills, Empire, Wilfley, and Deister-Overstrom tables, and a flotation plant. Ore carries lead, copper, zinc, gold, and silver.

Two feet of galena and iron pyrite has been opened on the 300-ft. level of the Onondaga mine. Besides this the company has good developments throughout the property.

IDAHO SPRINGS.—Bonanza Mines Co. will develop the Bonanza claims on north slope of Albo mountain. George Taylor of Norton, Kansas, is president, and C. E. Angell of Independence, Kansas, secretary of this new concern.

IDAHO

BURKE.—Majestic Mining Co. is to resume work at its 13 claims north-east of this place. James Dunn is president. Ore carries lead and silver.

Hecla Mining Co.'s shaft is down 2000 ft., with 200 ft. to go. An additional depth of 1300 ft. is attained by driving in the Hecla, making a total depth of 3500 ft. Daily output is 1000 tons, of which 700 tons goes to the Gem and 200 tons to the Marsh mill. Crude ore sorted is up to 50 tons, and waste about 100 tons.

Federal Mining & Smelting Co.'s December operations resulted in a loss of $108,381, against a loss of $27,100 in November, and profit of $31,076 in October, $112,492 in September, and $259,728 in July. The December loss was due to an accident to the Morning mine's shaft.

KELLOGG.—According to G. S. Anderson, manager for the Big Creek Mining Co., east of Kellogg, ore shipments are soon to be started. At 2350 ft. in the adit the vein is 12 ft. wide. A streak in this carries 72% lead and 73 oz. silver per ton. There is also some high-grade copper ore on the foot-wall. To handle second-class ore a crusher and hand jigs are to be procured, while equipment costing $20,000 is proposed. This includes an aerial tram.

Bunker Hill & Sullivan M. & C. Co. is cross-cutting 500 ft. from No. 15 level, the deepest in the mine, to open ore developed on No. 14. No. 15 is 1200 ft. vertical below the Kellogg adit. The mill and smelter are working well.

WALLACE.—According to F. H. Skeels, manager of the Success mine, the orebodies below 1000 ft. are rarely continuous from one level to the next below. The shoots appear to be stronger near the ends of the vein and are found from 10 to 40 ft. from the granite contact. The widest points were on the 300-ft. level, narrowing at 600 ft., widening to the best ore at 1000 ft., and again narrowing at 1200 ft. From 1200 to 1600 ft. the ore is irregular, and the mine will probably be worked out at the latter depth. Up to July 1916, above the 1200-ft. level yielded 733,200 tons of ore, giving $1,900,000 in dividends. Since then there has been a loss of $150,000. Prospects in the east section are rather encouraging. On a 300-ton basis, all costs total $5.42 per ton. Reserves total 18,300 tons, assaying 3% lead, 13.6% zinc, and 1.5 oz. silver per ton.

The Silver Range M. & M. Co. has been organized at Spokane with a capital of $1,500,000. E. M. Burt, F. M. Williams, and Reuben Crandall of Spokane were incorporators.

WARDNER.—On the 600-ft. level of the East Caledonia the cross-cut has been driven 230 ft. since January 1, from which drifts are out 60 ft. each way on the vein. The workings are now under the shoot opened at 400 ft. R. J. White is manager.

MICHIGAN

HOUGHTON.—Quincy Mining Co. pays $2.50 per share on March 25, against $3 and $5 for previous quarters.

Calumet & Hecla reports as follows for January:

Mine	Pounds
Ahmeek	2,095,488
Allouez	737,779
Calumet & Hecla	6,111,104
Centennial	263,433
Isle Royale	1,038,562
La Salle	150,963
Osceola	1,309,533
Superior	179,837
White Pine	253,498
Total	12,140,197

MISSOURI

FLAT RIVER.—St. Joseph Lead Co. pays 50c. per share on March 20. Net income in 1917 was $5,610,274. This is equal to $3.98 per share.

JOPLIN.—Production of concentrate in the district last week was 4650 tons blende, 210 tons calamine, and 888 tons lead, averaging $55, $33, and $84 per ton, respectively. Total value was $340,259, making $3,122,341 in seven weeks.

Lucky Shot Mining Co.'s mine north of Carl Junction is now owned by the Joplin-Sapulpa Mining Co. controlled by H. G. Beard of Sapulpa, Oklahoma. Ore is at a depth of 150 ft., and assays 15 to 20% blende.

SAGINAW.—Extensive operations are being planned by the Griffith Lead & Zinc Co. on its 750-acre tract, until recently held under lease by the Saginaw Mining & Leasing Co., near Saginaw. When the ground is drained and opened a 350-ton mill may be erected.

MONTANA

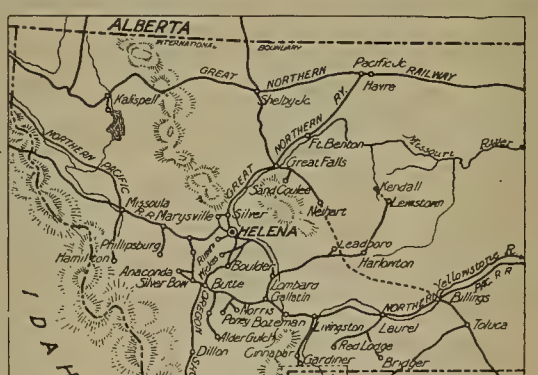
BUTTE.—Davis-Daly profit in January was $125,000, against $100,000 in December and $56,000 in November. The Colorado mine shipped 175 tons daily, 40% being 12 to 15% copper ore from the 2300, 2400, and 2500-ft. levels. The Hibernia mine shipped 75 tons of silver-zinc ore; shipments are now 100 tons per day. The Hibernia shaft is being deepened from 400 to 600 ft. Sixty men are employed at the Hibernia and 300 at the Colorado mine. The Davis-Daly payroll is reported as $60,000 per month.

Anaconda has reached 100% mechanical capacity in practically all departments. In labor efficiency, however, results are poor. Its production of electrolytic zinc has reached 100 tons daily, with prospects of increasing to 150 or 175 tons when market conditions demand.

Anaconda may have more labor troubles, as the local machinists' union voted on February 14 to strike unless the two men discharged last summer were reinstated. Electricians and other unions may strike in sympathy.

Butte Copper & Zinc Co. for 16 months ended November 30, 1917, reports gross value of ore sold $1,535,163, of which $510,150 was profit. Anaconda company was paid $202,292 account of lease, also $153,928 profit on lease. Net income at end of period was $119,772.

PHILIPSBURG.—This district is shipping 500 tons of manganese ore daily to the East, and within two or three months this quantity will be doubled. The deposits are known to persist to 400 ft. Among the principal companies operating are the Philipsburg Mining Co., a subsidiary of the Bi-metallic Mining Co.; the Western Ore & Mining Co., back of which is the Cambria Steel Co.; the Beaver Creek Mining Co.; and the Morony Estate. The Philipsburg company is shipping daily about 125 tons, the Western Ore 100, the Beaver Creek 75, and the Morony Estate 60 tons. The Philipsburg company has completed the construction of a 300-ton concentrator,



MAP SHOWING SITUATION OF PHILIPSBURG, MONTANA

which has been operating successfully on low-grade manganese ores for a while. A product of 40% manganese or better is aimed at from the milling of ores carrying around 30 to 35% manganese, with up to 15 to 20% silica. The general grade of the manganese shipments from Philipsburg is around 45%, with some shipments ranging higher.

NEVADA

COPPERFIELD.—Winze 30 ft. deep has been sunk on 8 in. of $300 ore opened in the old State Line mine by Hiell, lessee, several weeks ago. At depth of 60 ft. from surface, vein is 4 ft. wide, maintaining the rich streak. Vein is considered to be extension of No. 4 of the Nixon-Nevada adjoining, in which there was 4 ft. of $150 ore.

On No. 1 vein of Nixon-Nevada, where a winze is being sunk in the north drift, there is 12 in. of 50% copper ore. This and Washoe company may share in expense of proposed adit that is to prospect at depth a number of veins which run with and into the big dike or contact crossing both properties.

FALLON.—Silver-gold ore is reported discovered 28 miles south of this agricultural centre. Jack Davis of Reno has named the place Silver Cliff, and with others is organizing Silver Cliff Mining Co.

GOLDFIELD.—Jumbo Junior is extracting good shipping ore from the winze below the 880-ft. level. Vein is from 18 to 24 in. wide. Operations are conducted through the Jumbo Extension's Velvet shaft.

Driving east from the 1950-ft. level of Atlanta property is under way, and junction of Atlanta and West veins should be found within 150 ft., according to indications. Flow of water has lessened, and the manager, A. I. D'Arcy, is confident that a zone of enrichment will be opened. Prospecting of the Atlanta vein has been resumed at 1750 feet.

A. D. Parker, president of the Florence company, is to confer with the owners of the Red Hill-Florence over the vein recently opened by the latter. Red Hill-Florence maintains that the new vein has its apex in Red Hill territory and dips into Florence ground, but Florence people are inclined to assert part ownership. It is thought by leading men here that the two properties will be consolidated. The vein was discovered at a depth of 400 ft., and showed much rich ore.

LUNING.—Flotation plant near Luning and reverberatory furnace near Sodaville are to be erected, according to Mark Walser of the Wedge Copper Co. Eastern people are to do this, and the deal involves the sale of the entire property interests of the Wedge company and those of the Fermina Sarrias estate adjoining, also taking over the Darms coal property of 1600 acres at Coaldale.

On 1000-ft. level of the Calavada is an 18-in. vein of ore assaying 2% copper.

John Marcalja, leasing on Mary claim of Iroquois Copper Co., is now opening 19 to 23% ore, double that of recent assays. Shipments for months averaged 10%.

MANHATTAN.—In the apex suit of Morning Glory v. White Caps the latter won. It is reported in local mining circles that the Morning Glory company is to appeal. The case occupied court six weeks and cost the contestants approximately $200,000. Six attorneys and several engineers and geologists were retained. The orebody was in a faulted limestone area. Decision practically makes vertical boundaries in this district.

NEW MEXICO

MOGOLLON.—Mogollon Mines Co. cut its No. 1 orebody on the 900-ft. level last week. This is nearly 200 ft. deeper than other openings. Grade and width are good. This vein shows a vertical extent of over 900 feet.

Oaks Co. is installing a compressor on its Deep Down property.

Construction at Socorro plant is being increased, and an effort is being made to have mill operating by May 1.

OKLAHOMA

Concentrate production of the zinc-lead region last week was 3046 tons blende and 482 tons lead, valued at $208,150.

OREGON

GOLD HILL.—Herbert Brewitt and C. W. Scott of Tacoma, Washington, officials of the Manganese Mining Co. of that city, are here inspecting the new plant at their Lake Creek manganese mine east of here. Twenty men are employed. The company has recently spent $30,000, and development promises to have an important bearing on this region. The poor condition of the road is hampering haulage to shipping point.

The McKinly copper mine, consisting of 12 claims lying 12 miles east of Gold Beach, has been sold by Delmer Colegrove and associates of Gold Beach, Oregon, to the owners of the Takilma Smelting Co. at Takilma, Oregon. These mines have long been known for their rich ore, and it is reported that the new owners will commence operating at once.

Hauling chrome and copper ore from the Waldo district to shipping at Water Creek on the Grants Pass-Crescent City railway continues only in a small way, on account of bad roads.

UTAH

Interest in oil-shale possibilities of this State continues. These deposits contain a much higher oil content than those profitably worked in Scotland and France. The oil-bearing beds of Utah are also thicker, and because of the peculiar topography of the plateau region where they are found are much more easily mined than are the foreign shales. Several experimental plants of limited capacity are being erected in Utah, all being adaptations of the Scotch method of distillation.

ALTA.—At the second annual meeting of the Emma Consolidated Mines Co., held at Wilmington, Delaware, George Graham Rice was re-elected president, W. B. Ridgely vice-president, and J. H. Weinberg secretary. To January 23, 1918, shipments totaled 9124 tons of ore averaging $27.29 per ton, smelter settlements realizing $253,226.

BINGHAM.—For failing to report on time at the Utah Copper Co.'s mills, 157 men were recently discharged; but were reinstated by the general manager, R. C. Gemmell. A dispute over the train schedule brought on the trouble.

Yampa mine of Tintic Mining & Development Co. will close for good on March 1. This has been a large producer.

EUREKA.—Arrangements are almost completed for exploring a large tract of mineral land in the Erickson district, some distance west of Eureka. The new company to be organized for this work is to be known as the Majestic Copper Mining Co. It will have a capitalization of $1,000,000, shares $1 par. Associated with Charles Stauffenberg will be Harry Webber Jr. of New York and C. S. Humphreys of Chicago, as well as other prominent Eastern people. This property was located many years ago by William Stauffenberg, one of the pioneers of this district, who died about a year ago. It has been opened to some extent, and disclosed some splendid copper ore.

TINTIC.—The Tintic Milling Co. shipped 31 tons of bullion worth $1200 per ton to Eastern refineries. This is the result of two weeks' work.

The Tintic Drain Tunnel Co.'s adit is in 200 ft. in loose porphyry. Hand drilling has been done so far. Two shifts are employed.

WASHINGTON

CHEWELAH.—Washington Water Power Co. has arranged with the Stevens County Light & Power Co. to provide power for the magnesite quarries and copper mines of this

county. The power will be taken from the recently completed plant at Long lake, 20 miles south of Spokane.

REPUBLIC.—Among the papers read at the recent convention of the Northwest Mining Association at Spokane was one by E. L. Tate, entitled 'Future of Republic Camp.' Those who have watched the ups and downs of this district should secure a copy of the address.

The Knob Hill company shipped about 530 tons of ore during January. This ore came from the 200-ft. level and assays from $9 to $15 per ton.

AFRICA

TRANSVAAL

JOHANNESBURG.—Cables on February 16 report tremendous rain in this and other parts of South Africa. Johannesburg received 14 in., but mining operations were not hindered much.

CANADA

BRITISH COLUMBIA

ANYOX.—At the Granby company's smelter extensions are being made to the furnace and converter buildings. A new copper-casting machine is in use. The 20-ft. converters have not arrived, the slag-haulage system has not been started, and the slag-casting machine remains to be erected. Payrolls of the Granby company for operation of the mines and smelter at Anyox were more than $2,000,000 in 1917, according to 'Granby News,' an official monthly.

KALSO.—On February 1 the Utica company shipped a carload of ore to the International smelter at Tooele, Utah. The estimated metal content is 200 to 225 oz. silver, 20% lead, and 15 to 17% zinc, the lot valued at $12,000. C. B. White is superintendent.

TRAIL.—During the last 10 days of January the Consolidated company's smelter received 11,547 tons of ore. The Centre Star, Rossland, contributed 3498 tons, Le Roi, 3369 tons, and Sullivan, 1858 tons of zinc ore.

ONTARIO

COBALT.—Kerr Lake company produced 204,641 oz. silver during January, against 203,048 oz. in December.

The Adanac Silver Mines Co. on February 14 increased its capital from $2,500,000 to $3,000,000. The money raised is for further exploration.

CHILE

Cerro de Pasco company has declared a quarterly dividend of $1 per share, plus an extra of 25 cents.

Braden Copper Co. produced 6,200,000 lb. in January, compared with 4,798,000 a year ago, and 5,836,000 lb. in December.

Grading of the railroad, to connect the Andes Copper Co.'s mine with ocean transportation, has been about finished, and with the equipment of this line, material for the quick development of the orebodies will be rushed. It will be two or three years before production is started.

MEXICO

SONORA

CANANEA.—Cananea Consolidated Copper Co., Montezuma Copper Co., Democrata Mining Co., and El Tigre Mining Co. have been granted permission to pay employees and all State obligations with United States silver coin, silver certificates, or Federal Reserve notes.

Greene Cananea Copper Co. produced in January 3,130,000 lb. copper, against 1,650,000 lb. in December. From July to November, inclusive, the property was closed owing to differences with the Mexican government, but is now getting into its old stride.

EL TIGRE.—On February 7, at Kansas City, Missouri, the Lucky Tiger Combination company declared its regular monthly dividend of 5c. per share, plus an extra of equal amount. January earnings were $68,000.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

JAMES P. GASKILL is at Los Angeles.

AUGUSTUS LOCKE is at Mazatlan, Mexico.

OTTO SUSSMAN is at Blackwell, Oklahoma.

F. A. RICHARDS is here from South Porcupine.

ANDREW MCFARLANE of Tucson, Arizona, is in New York.

WALTER DOUGLAS has returned from Arizona to New York.

LEON J. PEPPERBERG is in the oilfield of Mineral Wells, Texas.

W. W. MEIN has returned from Copper Cliff, Ontario, to New York.

CHARLES JANIN has returned from Washington to San Francisco.

M. A. PETERSON, of the United Verde, Extension, is at Pittsburgh.

ALFRED E. BROOKS, Major in the Expeditionary Force, is in France.

JOHN A. RICE has returned to San Francisco from Cananea, Mexico.

A. G. MCGREGOR is making a trip of inspection through Peru and Chile.

E. GYBBON SPILSBURY has moved his office to 29 Broadway, New York.

J. H. G. WOLF is acting in an advisory capacity on oil at Washington.

C. S. MCKENZIE has joined the 27th Engineers at Camp Meade, Maryland.

J. K. TURNER is a member of the Federal Exemption Board for the State of Nevada.

H. VINCENT WALLACE has returned from Mexico and is now residing at Los Angeles.

F. L. RANSOME is at Bisbee, on his way to examine the Terlingua quicksilver district in Texas.

H. C. ENOS is making examinations of mining properties in the State of San Luis Potosi, Mexico.

SEELEY W. MUDD, Major in the Engineer Officers Reserve Corps, is now stationed at Washington.

O. E. LEROY, economic geologist for the Canadian Geological Survey, has died of wounds in France.

HENRY U. BIRDSEYE has been elected second vice-president of the Detroit Graphite Co., at Detroit, Michigan.

J. G. ALEXANDER has returned to Nacozari to resume the management of the Nacozari Copper Company.

WILL C. HIGGINS, editor of the 'Salt Lake Mining Review,' passed through San Francisco on his annual tour.

THORVALD J. ANDERSEN of New York is in San Francisco, on his way to La Grange, Stanislaus county, California.

O. D. WELSCH, recently at Anyox, B. C., has enlisted with the 319th Engineers at Camp Fremont, California.

J. W. WRIGHT has been appointed Second Lieutenant in the U. S. Medical Reserve Corps at Deming, New Mexico.

POPE YEATMAN has succeeded EUGENE MEYER JR. as metal expert on the Council of National Defense, at Washington.

RUSH M. HESS is examining manganese deposits in the south-eastern States, with headquarters at Anniston, Alabama.

R. S. HANDY, superintendent of the Bunker Hill & Sullivan mill, is acting in an advisory capacity at the Alaska Juneau mill.

LAWRENCE and ARTHUR HASTINGS, two sons of JOHN B. HASTINGS, are privates in the American Expeditionary Force in France.

GEORGE H. GARRY, formerly of the U. S. Geological Survey and at present consulting geologist for the Tonopah Belmont company, is making a geological examination of the Tonopah Midway Mining Co.'s property.

THE METAL MARKET



METAL PRICES

San Francisco, February 26

Aluminum-dust (100-lb. lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.90
Antimony, cents per pound	15.50
Antimony (wholesale), cents per pound	13.50
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67
Pig-lead, cents per pound	7.25— 8.25
Platinum, soft and hard metal, respectively, per ounce	$108— 116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	17.50

Antimony imports into the United States during 11 months of 1917 totaled 19,995 tons, compared with 13,069 tons in all 1916. Metal in warehouse on November 30 each year was 4398 and 1511 tons.

Recent bidding for two Government contracts for antimony—30,000 and 100,000 lb., respectively—brought out a large number of bids, the lowest for these being 13.75 and 13.87½c. per lb., from the same firm. Prices ranged up to 15.75 cents.

ORE PRICES

San Francisco, February 26

Antimony, 45% metal, per unit	$1.05
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.85— 1.00
Magnesite, crude, per ton	$8.00—10.00
Manganese: basis 40 to 44% Mn and 8% SiO_2, cents per unit	70.00—80.00
Tungsten, 60% WO_3, per unit	26.00
Molybdenite, per lb., 85% MoS_2	$2.15

Chrome production of the United States in 1917 totaled 47,035 tons, nearly all from California and Oregon. Imports were 115,945 tons.

EASTERN METAL MARKET

(By wire from New York)

February 26.—Copper is quiet. Lead is inactive, though firm. Spelter is dull, but steady. Platinum is unchanged at $108 to $116.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Feb.	20 ..... 85.37	Jan.	15 ..... 90.04
"	21 ..... 85.37	"	22 ..... 89.29
"	22 Holiday	"	29 ..... 87.35
"	23 ..... 85.12	Feb.	5 ..... 86.62
"	24 Sunday	"	12 ..... 85.93
"	25 ..... 85.50	"	19 ..... 85.48
"	26 ..... 85.12	"	26 ..... 85.30

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	....	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

Tone of silver market at end of January was easier in London, according to Samuel Montagu & Co. As the demand was fairly good, though not active, lower prices were attributed to freer supplies of the metal. Exchange with Shanghai, where a certain amount of speculation is rife, did not move in sympathy, but actually hardened. Stocks at Shanghai were 27,700,000 oz. as bars and $13,000,000 (Mexican). Issue of one rupee notes (32 cents) in India is a success, and is relieving the silver situation. Continued shrinkage of Indian Treasury holdings of silver, and the impossibility of silver supplies expanding correspondingly to the abnormal demand for coinage, render the note-issue timely.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Feb.	20 ..... 8.00	Jan.	15 ..... 7.87
"	21 ..... 8.00	"	22 ..... 7.87
"	22 Holiday	"	29 ..... 7.87
"	23 ..... 8.00	Feb.	5 ..... 7.87
"	24 Sunday	"	12 ..... 8.00
"	25 ..... 8.00	"	19 ..... 8.00
"	26 ..... 8.00	"	26 ..... 8.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	....	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Exports of spelter and sheet-zinc in 1917 and 1916 are as under, in pounds:

	1917	1916
Domestic ore	276,784,653	297,773,217
Foreign ore	127,777,499	86,457,195
Sheet zinc	31,650,876	28,501,869
Total	436,213,028	412,732,281

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Feb.	20 ..... 23.50	Jan.	15 ..... 23.50
"	21 ..... 23.50	"	22 ..... 23.50
"	22 Holiday	"	29 ..... 23.50
"	23 ..... 23.50	Feb.	5 ..... 23.50
"	24 Sunday	"	12 ..... 23.50
"	25 ..... 23.50	"	19 ..... 23.50
"	26 ..... 23.50	"	26 ..... 23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	....	Aug.	27.03	27.42	....
Mch.	26.65	36.00	....	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Copper exports during recent years were as under, according to the 'American Metal Market':

Year	Pounds	Value*
1917	1,125,397,404	$355,222,610
1916	784,103,644	230,676,765
1915	681,917,955	125,136,278
1914	840,080,922	117,188,350
1913	926,241,092	144,909,117
1912	775,000,658	126,770,167
1911	786,552,208	103,327,846
1910	708,316,543	95,505,346

*Includes value of copper manufactures.

LEAD

Lead is quoted in cents per pound. New York delivery.

Date		Average week ending	
Feb.	20 ..... 7.10	Jan.	15 ..... 6.75
"	21 ..... 7.10	"	22 ..... 6.98
"	22 Holiday	"	29 ..... 7.00
"	23 ..... 7.10	Feb.	5 ..... 7.00
"	24 Sunday	"	12 ..... 7.00
"	25 ..... 7.10	"	19 ..... 7.08
"	26 ..... 7.10	"	26 ..... 7.10

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	....	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending

Date			
Jan.	29 ..... 125.00	Feb.	12 ..... 125.00
Feb.	5 ..... 125.00	"	19 ..... 115.00
		"	26 ..... 115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	.....
Feb.	295.00	126.25	.....	Aug.	74.50	115.00	.....
Mch.	219.00	113.75	.....	Sept.	75.00	112.00	.....
Apr.	141.60	114.50	.....	Oct.	78.20	102.00	.....
May	90.00	104.00	.....	Nov.	79.50	102.50	.....
June	74.70	85.50	.....	Dec.	80.00	117.42	.....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	....	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Tin imports during 1917 totaled 68,996 tons, compared with 66,624 tons in 1916. Of this, 74% came from England and the Straits. Holland contributed 20%.

Eastern Metal Market

New York, February 20.

Milder weather has continued another week in this part of the country and has been a great aid in relieving railroad congestion, the coal shortage, and industrial troubles. This, combined with the fact that the last of the heatless Mondays was over a week ago—temporarily at least—has imparted a better tone to the market, and affairs are nearing normal war conditions. All markets, however, continue quiet.

Copper output has lessened, and a temporary scarcity exists for domestic consumers not having war work.

Tin is still scarce for spot delivery, but inquiry for and business in futures are active.

Lead is strong, but not active.

Zinc continues lifeless but steady.

Antimony is again lower on poor demand.

In the steel industry conditions are improving decidedly. By the end of this week operations will probably be at 80% capacity. As the time draws near (April 1) for a reconsideration of Government prices, the trade keenly hopes that Washington will not strive further to destroy incentives to maximum output. Mounting costs and restricted operation for several weeks will make it hard to meet capital charges of the first quarter. A three months period of price-fixing is regarded as too short. With only five weeks left before entering the next period, few new commitments are expectd. Pig-iron buying in large volume is being restrained by the conservative attitude of makers.

COPPER

There appears, on the surface, to be a temporary shortage of copper. This is inferred from the fact that the Copper Producers Committee has recently restricted shipments and sales to consumers not having Government work. While this class of consumers is not extensive, they have been supplied lately regularly with what they needed, but this has been restricted recently. The cause is understood to be lessened output, though facts are as hard to obtain as ever. Evidently railroad congestion, severe weather, coal shortage, and other industrial troubles have interfered with the normal output of both refined and raw copper—this is admitted by one large company. Supporting this probably is the statement that the January output of 15 companies was 9,200,000 lb. less than in that month of 1917. The restriction or shortage is believed to be only temporary. Government prices of 23.50 and 24.67½c. continue to rule. It is understood that large contracts for shells and war munitions are about to be placed by the Government, and will require a large amount of copper.

TIN

Market has been quiet in the past week, and sales are reported to have been light. Sellers are not numerous and consumers are becoming anxious as to their future supply. High prices for all grades are a cause of reluctance to enter the market. On Monday of this week there were sales, in moderate quantities, of all grades except Straits tin; while yesterday was a quiet day. Off-grade tin is in good demand, and consumers are buying freely, especially Chinese tin, the production of which was said to be at a new rate. The fact that off-grade tin is not up to Government specifications is the reason why the demand is so good; it is not liable to commandeering. It is possible that one or more cargoes of tin have been sunk recently. A reason for this probability is the fact that in the past week the London market soared to £327 per ton for spot Straits—a record price. This was a source of some anxiety here, and resultant higher prices. A week ago the quotation in London was £308, but by yesterday it had fallen to £316. The previous high price—a few weeks ago—had been £309. Arrivals to February 19, inclusive, were 850 tons, with 4900 tons estimated afloat. Spot Straits tin continues nominal at about 85c. per lb., New York.

LEAD

Market continues dull but quite firm. Advance of the leading producer—A. S. & R. Co.—early last week, reported in our last letter, has not affected the market as it often has. Its new price of 7c. has usually been raised by the outside market by at least ¼c. per lb., the increase this time has been but slight. Quotation by independents is about 7.10c., New York, or 6.95c., St. Louis. Spot lead has sold at 7.12½c., New York. There has been fair buying of small lots because of delayed shipments from the West, and these have gone at 7.12½ to 7.25c., New York, for carloads. Sellers are not anxious to do business unless the buyer can procure a shipping permit. Lead exports in January are reported as 6939 gross tons.

ZINC

The feature of the zinc market since writing last has been the announcement from Washington that a price of 12c. per lb. for grade A zinc has been agreed upon between the War Industries Board and producers, but subject to revision June 1. The official statement, as foreshadowed in this letter, was made by the President last Thursday. The usual stipulations are laid down, and conditions imposed. Sheet-zinc was also fixed at 15c. per lb. base, with plate-zinc, which is sheet-zinc ¼ in. thick and heavier, fixed at 14c. per lb. Settlement of the grade A price, after over eight months of suspense, is a source of relief as well as satisfaction. A fair profit is obtainable for makers of grade A, as well as of sheet and plate-zinc. The grade A price is not as high, of course, as some had hoped for. It is estimated in the trade that while the spread in August 1914 between sheet-zinc and prime Western, St. Louis, was only 2.15c., it is now 7.25c., or the difference in one case between 7 and 4.85c., and in the other between 15 and 7.75c. The general zinc market is as dead as ever. The Government is buying and absorbing large quantities of grade A and other grades, but other buying is not large. Regular consumers are spasmodically purchasing prime Western and special brands in small amount, as their immediate needs require. These constitute galvanizers, brass-makers, and others. The quotation for prime Western is unchanged but firm at 7.75c., St. Louis, and 8c., New York, for early delivery, with future positions a little higher. Zinc exports for January are reported as having been 10,550 gross tons.

ANTIMONY

In the absence of any demand the market is lower at 13.50 to 13.75c., duty paid, New York, for Chinese and Japanese grades for prompt or February delivery. The market is somewhat unsettled.

ALUMINUM

With the market lifeless and with no increase in demand, No. 1 virgin metal 98 to 99% pure, is steady and unchanged at 36 to 38c., New York, for prompt delivery.

ORES

Tungsten: Prices are unchanged at $20 to $26 per unit in 60% concentrate, the higher price being asked for scheelite. Sales of wolframite have been fairly liberal in the past week. To what extent the new proclamation on licensed exports and imports will affect the tungsten or other ore-markets is as yet difficult to say. Ferro-tungsten is unchanged at $2.35 per lb. of contained tungsten.

Recent Publications

INFLUENCING MEN IN BUSINESS: THE PSYCHOLOGY OF ARGUMENT AND SUGGESTION. By Walter Dill Scott, Ph.D. Second edition. Pp. 186. The Ronald Press Co., N. Y., 1917. For sale by MINING AND SCIENTIFIC PRESS. Price, $1.50.

Dr. Scott is right in claiming that business success is chiefly dependent upon the ability to influence men. The American people have been interested in men mainly for the sake of getting something out of them, which is at the root of business. They have not been interested in men as men to anything like the extent that they have been interested in men as potential placers of orders for goods. It is difficult to dissimulate in this matter, wherefore the American has developed a brutal type of frankness, which is usually regarded as a particularly American virtue. The Frenchman, on the other hand, is seriously interested in other men, and this interest is quite largely independent of any knowledge as to the persistance of the person in question. The result is a special *bonhomie*, which has proved one of the most useful factors in the commercial advancement of the French people. When the American undertakes to imitate this adroitness to win the confidence and favor of others, he usually does it with self-consciousness, which is likely to prove damaging to his interests. It is in the analysis of such relations as these that Dr. Scott's book becomes valuable, and it is to be commended to all young men as a stimulating guide toward that knowledge of human nature which, coupled with sincerity and diligence, will lead to success.

ROADS FOR MINES. By George R. Fansett. 13 pp., ill. Bulletin No. 72, University of Arizona, Tuscon.

COST ACCOUNTING FOR OIL PRODUCERS. By Clarence G. Smith. 123 pp. Bulletin 158, Petroleum Technology 43, U. S. Bureau of Mines.

CENSUS OF MANUFACTURERS 1914: IRON AND STEEL, INCLUDING ROLLING-MILL, WIRE, TIN-PLATE, AND TERNEPLATE INDUSTRIES. Prepared under the supervision of W. M. Steuart. 68 pp., ill. U. S. Bureau of Census.

GOLD, SILVER, COPPER, LEAD, AND ZINC IN CALIFORNIA AND OREGON IN 1916. By Charles G. Yale. Pages 215 to 267, Mineral Resources of the United States. U. S. Geological Survey.

ZINC-PYRITE DEPOSITS OF THE EDWARDS DISTRICT, NEW YORK. By David H. Newland. 72 pp., ill. Bulletin 2, New York State Defense Council.

TESTS OF OXYACETYLENE-WELDED JOINTS IN STEEL PLATES. By Herbert F. Moore. 26 pp., ill. Bulletin No. 98, Engineering Experiment Station, University of Illinois.

THE MINERAL INDUSTRIES OF THE UNITED STATES. COAL PRODUCTS: AN OBJECT LESSON IN RESOURCE ADMINISTRATION. By Chester G. Gilbert. 16 pp. Bulletin 102, Part I, Smithsonian Institute. United States National Museum.

ANNUAL REPORT OF THE DIRECTOR OF THE MINT, FOR THE FISCAL YEAR ENDED JUNE 30, 1917. 271 pp. Government Printing Office, Washington.

BAUXITE AND ALUMINUM IN 1916. By James M. Hill. Pages 159 to 170, Mineral Resources of the United States. U. S. Geological Survey.

SALT, BROMINE, AND CALCIUM CHLORIDE IN 1916. By Ralph L. Stone. Pages 213 to 221, Mineral Resources of the United States. U. S. Geological Survey.

CHROMITE IN 1916. By J. S. Diller. Pages 21 to 38, Mineral Resources of the United States. U. S. Geological Survey.

MANGANESE AND CHROMIUM. By E. S. Boalich. 31 pp., ill. California State Bureau of Mines.

GOLD, SILVER, COPPER, AND ZINC IN NEW MEXICO AND TEXAS IN 1916. By C. L. Henderson. Pages 185 to 213, Part I, Mineral Resources of the United States. U. S. Geological Survey.

SURFACE WATER SUPPLY OF THE UNITED STATES IN 1915. PART III, OHIO RIVER BASIN. By N. C. Glover and others. 171 pp., ill. Water-Supply Paper 403. U. S. Geological Survey.

SURFACE-WATER SUPPLY OF THE UNITED STATES, 1914. PART IX, COLORADO RIVER BASIN. By Nathan C. Grover and others. 198 pp., ill. Water-Supply Paper 389. U. S. Geological Survey.

SURFACE-WATER SUPPLY OF THE UNITED STATES, 1914. PART X, THE GREAT BASIN. By N. C. Grover and others. 299 pp., ill. Water-Supply Paper 390. U. S. Geological Survey.

SHORTER CONTRIBUTIONS TO GENERAL GEOLOGY, 1916. By David White. 395 pp., ill., map. U. S. Geological Survey.

MANGANESE DEPOSITS OF THE CADDO GAP AND DE QUEEN QUADRANGLES, ARKANSAS. By Hugh D. Miser. 63 pp., ill., map. Bulletin 660-C. U. S. Geological Survey.

THE CORSICANA OIL AND GAS FIELD, TEXAS. By George C. Matson and O. B. Hopkins. 41 pp., ill., map. Bulletin 661-F. U. S. Geological Survey.

SURFACE-WATER SUPPLY OF THE UNITED STATES, 1915. PART VIII, WESTERN GULF OF MEXICO BASINS. By N. C. Glover and others. 110 pp., ill. Water-Supply Paper 408. U. S. Geological Survey.

SURFACE-WATER SUPPLY OF THE UNITED STATES, 1916. PART VIII, WESTERN GULF OF MEXICO BASINS. By N. C. Glover and others. 106 pp., ill. Water-Supply Paper 238. U. S. Geological Survey.

PRODUCTION OF COAL AND COKE IN CANADA IN 1916. By John McLeish. 46 pp. Mines Branch, Canadian Department of Mines.

GOLOGY OF MASSACHUSETTS AND RHODE ISLAND. By B. K. Emerson. 289 pp., ill., map. Bulletin 597. U. S. Geological Survey.

HYDRAULIC CONVERSION TABLES AND CONVENIENT EQUIVALENTS, being contributions by the hydrologs of the United States. 23 pp. Water-Supply Paper 425-C. U. S. Geological Survey.

THE BOWDOIN DOME, MONTANA. By Arthur J. Collier. 26 pp., map. Bulletin 661-E. U. S. Geological Survey.

GOLD, SILVER, COPPER, AND LEAD IN SOUTH DAKOTA. By C. L. Henderson. Pages 269 to 282, Mineral Resources of the United States, 1916. U. S. Geological Survey.

ADVANCED FIRST-AID INSTRUCTIONS FOR MINERS. By a Committee of Surgeons. Government Printing Office, Washington.

PETROLEO CRUDO COMO COMBUSTIBLE. By Edwardo M. Wilson. 80 pp., ill. Departmento de Falleres Graficos de la Secretaria de Fomento.

IRON ORE OCCURRENCES IN CANADA. By E. Lindeman and L. L. Bolton. 71 pp., ill., maps. Mines Branch, Canada Department of Mines.

AN INVESTIGATION OF THE IRON ORE RESOURCES OF THE NORTH-WEST. By W. H. Whittier. 128 pp. Bulletin No. 2. University of Washington.

ANNUAL REPORT OF THE SECRETARY OF INTERIOR FOR THE FISCAL YEAR ENDED JUNE 30, 1917. Government Printing Office, Washington, D. C.

REPORT ON CO-OPERATION IN AMERICAN EXPORT TRADE. Part I, 380 pp. Part II, 597 pp. Government Printing Office, Washington, D. C.

APPROVED ELECTRIC LAMPS FOR MINES. By H. H. Clark and L. C. Isley. 59 pp., ill. U. S. Bureau of Mines.

PHOSPHATES IN CENTRAL KENTUCKY. By W. C. Phalen. 77 pp., ill., map. Kentucky Geological Survey.

NICKEL DEPOSITS OF THE WORLD. A re-print from the Report of the Royal Ontario Nickel Commission. 286 pp., ill., map. Ontario Bureau of Mines, Toronto.

U. S. Geological Survey:

GEOLOGIC ATLAS OF THE UNITED STATES. Leavenworth and Smith Folio. By H. Hinds and F. C. Greene.

GEOLOGIC ATLAS OF THE UNITED STATES. Detroit Folio. By W. H. Sherzer.

BLAST-FURNACE BREAKOUTS, EXPLOSIONS, AND SLIPS, AND METHODS OF PREVENTION. By F. H. Willcox. 208 pp., ill. U. S. Bureau of Mines.

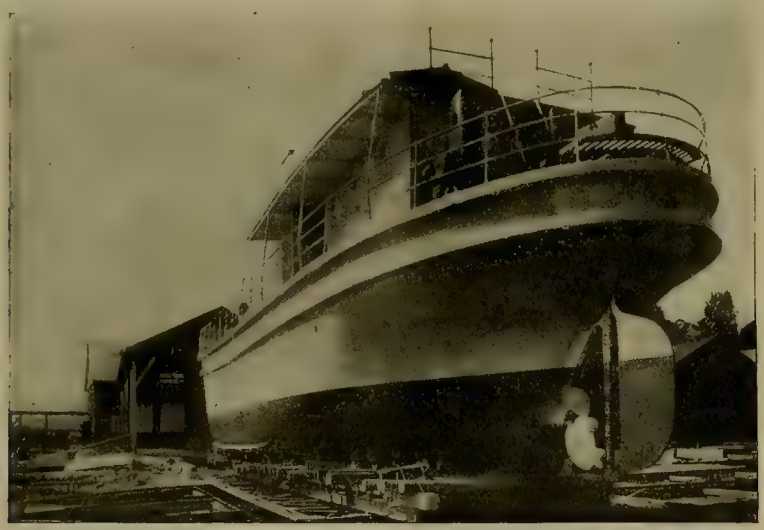
INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

CONCRETE SHIPS

The Portland Cement Association of Chicago has just issued a pamphlet entitled 'Concrete Ships,' which is of great interest at this time, when the building of reinforced concrete vessels is becoming an important factor in helping to solve the shipping problem. Some of the more striking features of this pamphlet are here presented.

Concrete is a ship-building material that can be quickly and readily obtained in large quantities, and the idea of concrete ships is neither new nor fantastic. There are many reasons why concrete is a logical material for ship construction. Several of these are especially applicable to the present situation: the materials required for constructing concrete vessels are available in necessary quantities, all along our coasts and waterways; little skilled labor is required; concrete vessels can be constructed rapidly, are reasonable in cost, will not burn, and are rot-proof and rat-proof.



VIEW OF HULL OF 400-TON MOTORSHIP BUILT BY THE FOUGNER COMPANY, NORWAY

Ship hulls must be made of a material that is stiff enough to prevent buckling between ribs. Concrete will accomplish that end. Shaping it to conform to the lines required is merely a matter of depositing it between forms having the desired lines. It can be finished so smooth that skin-friction will be reduced to a minimum and sea growths will find no opportunity for attachment. Concrete in its plastic state lends itself to any shape. There is no joining as required with wood. There are no rivets nor bolts to be loosened by jars or strains. Reinforced concrete uses steel most effectively and economically. More than ordinary speed in construction is made possible because the skeleton of reinforcement may be placed quickly and the ship launched as soon as the hull has been finished far enough to float the unloaded vessel. Sand, stone, cement, steel reinforcing bars, and structural-steel shapes are on the market, and usually may be obtained promptly. Therefore, the materials required for concrete-ship construction are generally and readily available.

Most of the labor necessary to build concrete ships is of the cheaper grade. Expert supervision is needed with any ship construction, but the number of skilled artisans required for concrete shipbuilding is small. Calking, heavy framework and bracing, fitting of plates, and shaping of planking are entirely eliminated in concrete ship construction. As the time required to construct a sufficient portion of the hull to permit floating the vessel is very short, because of the speed with which concrete may be placed, it is possible to make use of dry-dock facilities, allowing the vessel to float as soon as possible, and then to bring up material on scows and barges, thereby materially lessening the amount of handling of materials and increasing speed of construction.

As will be seen from the following examples of boats and barges now finished or under construction, the practicability of concrete for such structures is not questioned by those familiar with its possibilities. Concrete may be applied to or used in connection with the reinforcing framework of the hull by either of two methods: (1) Mixed and then placed in forms in the same manner as in the construction of buildings; (2) applied by means of a machine such as the cement-gun or similar apparatus, using compressed air or steam under pressure. In such cases fewer and simpler forms are required.

Early in 1917 a group of San Francisco capitalists formed the San Francisco Shipbuilding Co., to undertake the construction of sea-going vessels of concrete. The company is now

building an ocean-going cargo-vessel of nearly 5000 tons, that will be about 330 ft. long and 46-ft. beam. In constructing this vessel the reinforcement was welded together, thus reducing to a minimum the quantity of steel required, by avoiding laps that otherwise would have been necessary. Plans for this work were developed by Allan McDonald, of McDonald & Kahn, San Francisco. The original drawings indicated that the reinforcement used weighs less than the bolts needed in a wooden ship of equal dimensions, and that the hull will weigh less than that of a wooden ship; 2500-hp. turbine-engines equipped with reduction gears will be used as motive power. Progress in the construction of this, the largest concrete vessel yet to be built, has recently been shown at motion-picture theatres throughout the country. It is expected that work will be finished and the vessel launched early in 1918.

Companies have been formed in Bergen, Norway, and Buenos Aires, Argentina, to build concrete vessels after the same plans used in Norway at the Porsgrund Cement Casting Works. The Porsgrund plant builds the boats bottom up, an internal mold being used which is made in units that can readily be taken apart and re-assembled. Such a vessel is launched in the same position in which it is built, that is, bottom up, and by taking advantage through a special arrangement of interior compartments, a small amount of water is admitted so that the vessel soon after being launched rights itself. The general structure of the vessels is a series of transverse ribs with a thin shell, and because of the fact that it is cast bottom-side up, it is easier to control the density of the concrete along the bottom and lower side of the hull; consequently thinner sections can be used than might otherwise be possible.

The launching of such a 200-ton lighter was briefly referred to in a Norwegian paper as follows: The launching was done after heretofore unknown methods, namely, by letting the ship go into the water bottom up. This method was tried for the first time after calculations by the cement-works superintendent, Engineer Alfsen. The launching was a great success,



VIEWS TAKEN OF THE LAUNCHING AND SELF-RIGHTING OF A

and came out exactly as calculated. The barge of 200 tons capacity used about 15 to 20 minutes to right itself.

A series of photographs reproduced herewith illustrates several stages of the launching. 'Shipping' (New York), of November 3, illustrated by the above sketches, *A*, *B*, *C*, *D*, and *E*, the principles of launching, which were described as follows: The diagram *A* represents a section of the vessel immediately on taking the water. The inner mold divided into compartments is seen, together with the outer reinforced concrete hull of the vessel, and it will be observed that as yet there is no water in the middle compartment of the mold owing to the air not escaping rapidly enough through the vent pipes. As the air escapes, however, the water rises in this compartment, the vessel gradually sinking as it loses its buoyancy, until the water reaches the level of the two upper side-compartments which are also gradually flooded, so that a position is gradually reached, as shown at *B*, when the vessel is submerged to its maximum amount. The lower side-compartments are never flooded, and thus the vessel is in a state of unstable equilibrium, the centre of gravity being considerably higher than the centre of buoyancy as shown. If, now, from any cause whatever, the vessel heels to one side or the other, the weight of the hull and its contents, acting through the centre of gravity, and the pressure on the submerged area acting through the centre of buoyancy, form a couple, the moment of which tends to turn the vessel on a longitudinal axis as shown at *C*. The moment of this couple has its maximum value when the vessel is in the position shown at *D*, after which it gets gradually less and less until the vessel floats in the correct position as shown at *E*, when the moment of the couple is again zero, but the vessel is now in a state of stable equilibrium. The slightest list to one side or the other, after the vessel has been launched and the compartments filled, is thus sufficient to cause her gradually to heel completely over until she floats in a normal position. The flooded compartments are then pumped out, and the mold is removed, this being used again in the construction of another similar vessel.

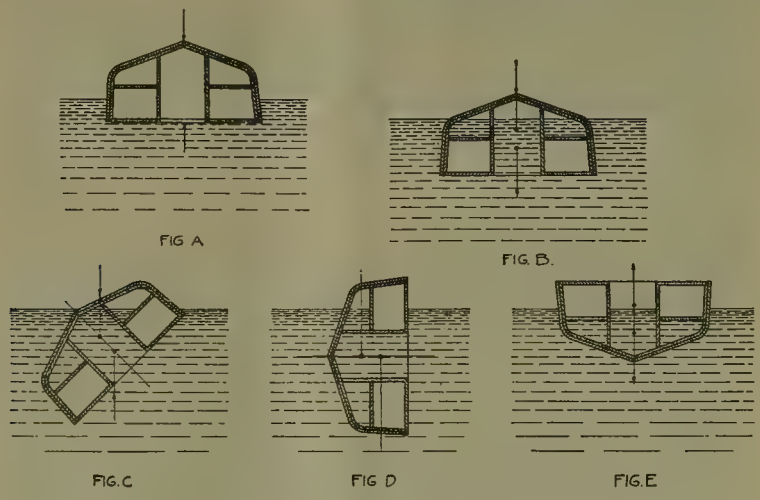


200-TON CONCRETE BARGE IN THE HARBOR OF PORSGRUND, NORWAY

Few persons are aware of the fact that the first example of

what today would be called reinforced concrete was a boat. In 1849 there was built by M. Lambot, of Carces, France, a row-boat which was nothing more nor less than reinforced concrete. This piece of work marked the starting point of the history, not only of concrete boat-building but of reinforced concrete. The process of construction was patented and its maker exhibited his work at a world's fair held at Paris in 1855. It is said that this boat is still in service. M. Lambot's work was investigated by the French government in 1850 but, as is often the case, further development was left to private initiative. In 1899, Carlo Gabellini, of Rome, Italy, began the construction of concrete scows and barges. His process had been so developed by 1905 that a 150-ton barge was constructed for the city of Civita Vecchia. The following year another barge was built for the military harbor at Spezzia, for the Italian navy. This barge, before acceptance, was put to the severe test of being driven against some piling and afterward being rammed by a steel tow-boat. Results of these tests were so satisfactory that construction of similar boats or barges followed. The 3-in. bulkheads extending from bow to stern. Reinforcing consisted of ½-in. square deformed bars covered with ½-in. No. 12 wire-mesh. Reinforcing was suspended in place from wooden beams and properly located by constructing a wooden platform placed at an elevation corresponding to the bottom of the barges. Bars were placed on 9-in. centres lengthwise, and 12-in. centres crosswise, after which the platform was removed and the network of reinforcing covered with wire-mesh. A ½ in. coat of cement-mortar was then applied to the wire-mesh. Ten running feet of the barge-length for its entire width was built up at one time.

In 1909, the United States occupied such an insignificant place in the shipbuilding world that the output of our yards fell below those of Japan. In that year, England led by producing 76% of the world's bottoms. Germany was a poor second; Japan a worse third. American ingenuity, organization, and enterprise is now being directed toward supplying the world with ships. Suitable lumber and timber are not quickly obtainable. Steel mills are overloaded with work. The ship-



DIAGRAMS ILLUSTRATING PRINCIPLES OF LAUNCHING BOATS, BOTTOM UP

first step in 'laying down' these vessels consists of placing reinforcement for the keel and ribs. This reinforcement, which usually consists of round steel rods, is then covered on the outside with ½-in. wire-mesh, to which a 1-in. coat of cement-mortar is applied by hand. Next, a somewhat thinner coat of mortar is placed on the inside, following which forms for the ribs and keel are put in place and concrete deposited for these parts of the vessel. These ribs run both longitudinally and transversely so that a checkerboard arrangement results, the pockets being 10 in. deep and the ribs about 2 in. wide. Over these ribs ½-in. wire-mesh is placed with a thin mortar-covering plastered on. Finally a third and coarser wire-mesh is pressed into the soft mortar and the entire surface troweled over. This completes the hull. Bulkheads are next concreted and the boat finished with a wooden sheer strake and gunwale.

Concrete barges built on the Panama Canal in 1911 proved good examples of what service such barges could render under adverse conditions. In this case concrete was selected as the construction material because no skilled labor for steel or wooden ship construction was available, nor could steel plates nor suitable seasoned timber be obtained within the time required. The design of these barges called for a structure 64 ft. long by 24 ft. wide, with a depth ranging from 5 ft. 4 in. to 5 ft. 8 in. Walls were made 2½ in. thick because the barges were intended for use merely as floats to carry suction pumps and engines. The only bracing of the hull consisted of two

building material that can be obtained in ample quantities in many localities at reasonable prices is concrete. It has been tried and found satisfactory. All that now remains is for energetic and farsighted marine engineers, shipbuilders, and designers in reinforced concrete, to work together in applying the knowledge which each has in his particular field to the requirements of shipbuilding. American ingenuity will not balk at the new problems that may arise. That they can be solved is now fully demonstrated.

'Continuous Filtration with the Portland Filter' is the title of Catalog No. 28-C, 1918, of the Colorado Iron Works Co., of Denver. This machine was first operated on a large scale at the Victor mill of the Portland Gold Mining Co., near Cripple Creek, and has since been installed at many mills and chemical works. Drum filters are so well known that no detailed description is necessary, beyond some special points claimed for the Portland type. Sizes vary from 6 ft. diameter, 2½-ft. face, and 45 sq. ft. filter area, to 14 ft. diameter, 20-ft. face, and 880 sq. ft. filter-area. Quantity filtered may vary from 200 to 1200 lb. of dry material per square foot of filter-area per 24 hours. Slime can be reduced in moisture from 50 or 60% to 15 or 20% The makers claim that the filter-valve is the simplest for this work. Panels are effectively isolated from one another, and wire winding is improved. Some interesting sketches and data are given, and the publication is a great improvement on previous ones.

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EDITORIAL

IN order to make room for Mr. Mackenzie's letter on Alaska Juneau affairs we have dropped one page of editorial.

ROASTING of ore is assuming greater importance with the increase in reverberatory smelting, and this practice is destined to grow still more rapidly in the future by reason of the modern tendency to utilize the fume in the manufacture of sulphuric acid. Every contribution to the subject of roasting is therefore interesting, and Mr. R. A. Watson has contributed a most useful article to this issue describing the new plant just erected at the Humboldt smelter in Arizona. We regret that a typographical error was made in the author's initials.

WHATEVER doubt may have been entertained in any quarter as to the sincere and close attachment of Austria to the destinies of Deutschthum will have been dissipated by the fact that Austria appears as the chosen instrument for communicating the German ultimatum to Rumania. The terms of peace, as stated by Count Czernin, the soft-spoken angel-trumpet of the Teutons, reveal commercial benefits in Rumania to be shared by Germany and Austria in such manner that it must now appear to everyone how inextricably interwoven are the purposes of the two Central Powers.

FEDERAL mediator Meyer has denied the petition of the miners and mechanics at Jerome for a horizontal increase of $1 per day in wages. He finds the costs of the necessaries of life at Jerome to be less than at Fort Worth, Texas, the comparison being made with Mr. Meyer's home-town, concerning which he is fully informed. The criticism of the wretched habitations of the workers, recently made in the MINING AND SCIENTIFIC PRESS, is confirmed by the mediator, who declares that rentals are 40% too high, and that it is the duty of the principal mining companies to provide better and cheaper cottages.

COPPER exportation from the United States reached the big total of 1,110,975,000 pounds, or 550,487 tons, in 1917. This represents 60% of the domestic mine production of copper last year. Shipments overseas in January are given as 115 million pounds, showing that the rate of exportation to our Allies continues undiminished. In 1913 Germany imported 310 million pounds from us, and in 1914 she managed to get nearly 200 million pounds before the seas were closed to her traffic. The bigness of our exportation of copper is further emphasized by the fact that these metal statistics do not include the copper shipped in the form of brass and finished products.

PLATINUM has been commandeered by the Government, and extraordinary efforts are being made to increase the supply, since the main dependence of this country has been upon the Russian resources, now closed to us by the circumstances of war. The metal at present is used chiefly as a catalytic agent in the so-called contact process for making sulphuric acid, and the shortage has become acute. Several thousand ounces could be consumed immediately, whereas the usual output of this country is only 700 ounces per annum, derived as a by-product in the working of gold placers. Mr. L. M. Prindle of the United States Geological Survey, has recently been investigating the possibilities of increasing the production from the gravels and beach-deposits of California and Oregon. Strenuous efforts are being made to encourage the development of these resources, and everyone that can add to the supply is urged to do so, even if he can contribute only a few ounces. The use of platinum in jewelry is prohibited.

ENERGETIC exploration and intensive development of certain needed mineral resources is earnestly recommended in a circular just issued by Mr. Franklin K. Lane, Secretary of the Interior, entitled 'How to Save Ships.' The purpose in view is revealed by that caption; ships are too urgently required for transporting troops and supplies to Europe to admit of dependence upon foreign sources of such metals and minerals as can be obtained in this country. Mr. Lane points out that their importation not only diverts shipping from the trans-Atlantic service, but produces a further demand for fuel and mining equipment abroad. The minerals specified are manganese, flake graphite, tin, tungsten, antimony, pyrite, magnesite, potash, and nitrates. A proposal has been made, and has received official en-

dorsement, for extending Government aid in the exploitation of such deposits, but it has not yet become law. Meanwhile, the remunerative prices obtainable for these products should encourage a prompt response, quite apart from the patriotic incentive that should bestir every true American to do all that he can.

JEROME J. DAY, of the Hercules mine, in the Coeur d'Alene, has established a scholarship in the School of Mines of the University of Idaho. The scholarship is for $250 per annum to run for four years. It will be awarded annually, so that four scholarships will be in effect concurrently. It is to be awarded to high-school students in Shoshone county, Idaho, the winners being selected by an examination to be held annually at Wallace. Not scholastic ability alone but manliness and character generally will be considered in making the award. We take pleasure in referring to this public-spirited act, because it sets an example that other successful miners should follow. In this connection the gift of $1,000,000 by Mr. Andrew Carnegie to McGill University is noteworthy. Mr. Carnegie states that he has been moved to this benefaction by the devoted service of the University during the War and the sacrifice it has made toward Canada's part therein; he also wishes his gift to be considered "an expression of appreciation and sympathy for the people of Canada on the part of their allies south of the border." All of which is well done, for McGill is a great and useful institution, and, as for Canada, we are proud to live next-door to her.

OUR ambassador to Spain, Mr. Joseph E. Willard, has been doing effective work. He has reached a satisfactory reciprocity agreement with the Government to which he is accredited, whereby supplies from Spain will be forwarded to our troops in France, in exchange for equipment to rehabilitate the Spanish railroads, as well as for lubricating oils of various kinds, and other needed materials. The King is reported to have taken a personal interest in smothering the discord that had arisen, which is not surprising in view of his previous efforts to stem the pro-German tide in his dominions. As we predicted recently, the elections have returned a majority for the party favoring a neutral attitude, which means that the influence of the Count of Romanones and the Marquis of Alhucenas, both of whom are friendly to the Allies, is in the ascendant. The new treaty should open many opportunities for American engineers and mechanicians. Our help is needed to improve the operation of the railroads; likewise American capital and experience should contribute to the rapid development of the coal deposits, which have been shown by recent explorations to be extensive and valuable. More than this, our friendly co-operation with Spain will promote an increase in the cordiality of our relations with the Spanish-American republics, which draw more inspiration from the mother country than our people generally have realized. Pan-Hispanism is more than a word; it expresses a definite movement that has taken concrete form since the outbreak of the War in many organizations for the encouragement of commercial and intellectual intercourse between the several Spanish-speaking countries. Both in the Americas and in the Iberian peninsula these peoples control large undeveloped resources to the unfolding of which we, more than any other nation, by virtue of our geographical and other relationships, should contribute effectively.

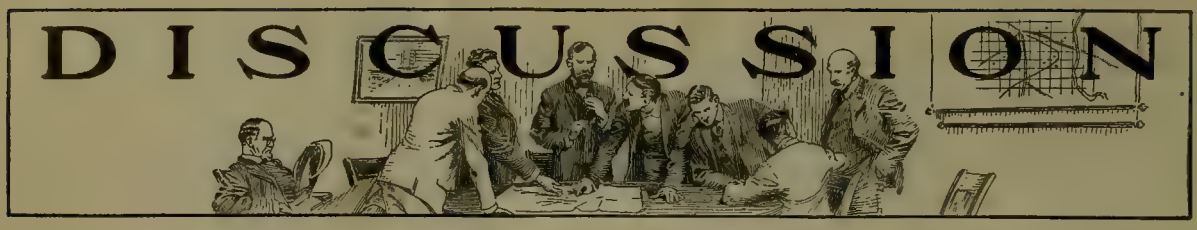
AMONG the interesting features of mining in the zinc region of Oklahoma is the financial participation of the Indians that happened to own the land on which the mines were opened. The Quapaw tribe was the most fortunate. One of them, Jackson Barrett, is credited with a subscription of $650,000 to the first Liberty Loan, a fact that proves that he is indeed a true American. An organization known as the United States Five Civilized Tribes War Savings Society has been formed to assist the campaign for war-savings and our bronze fellow-citizens are showing a fine spirit in the matter. Turning to more technical matters, we learn that among the modifications of the local milling practice is an attempt, suggested by Mr. Persifor G. Spilsbury, to grind the tailing from the rougher jigs in Hardinge mills using balls, so as to reduce the pulp to 1½ millimetres, before treatment on James tables, followed by flotation. Preliminary tests show a recovery of 80% by this method, as against 50% by the current practice. Whether this new departure prove successful or not, it is pleasant to record an intelligent effort to break away from the crudities of the Joplin tradition; indeed, it is safe to say that the introduction of real Western ideas into this Near Eastern mining region should prove usefully stimulating to progress.

OUR contemporary the 'Tonopah Miner' writes with considerable feeling concerning the plague of apex suits that sap the vitality of mining enterprise in Nevada, being moved to do so by the conclusion of the White Caps v. Morning Glory case, with a backward glance at the Booth v. Jumbo Extension and Jim Butler v. West End contests. Local opinion appears to favor the victory of the White Caps, because the litigation looked like the attempt of a neighboring company owning ground covering a small part of the orebody to take advantage of a legal technicality in order to get hold of the ore that had been originally found and developed by the White Caps. Such is the view taken by our contemporary, who asserts that the lawsuit has caused a "practical suspension of all new enterprise in the Manhattan district." The pleasure given by the adverse decision against the Morning Glory is said to be an "unconscious mass of expression of antipathy" against the apex law, and the 'Miner' has pledged itself to fight for the repeal of it. With the irritation thus expressed we are bound to feel sympathy, for it cannot be doubted that the undermining of property-rights caused by apex suits, usually the consequence of the natural vagaries of ore deposition, does intimidate enterprise. Unfortu-

nately, however, no repeal of the extra-lateral law would be retroactive and therefore it could not help the owners of claims already located in Nevada or in any other State, and even the introduction of vertical side-lines would not prevent the present owners of apex rights from invading later claims in pursuit of ore; in short, the depredation of the apex-owner would persist, whereas the new claim-holder would be unable to retaliate. The apex law is a lamentable fact.

Flotation Litigation

On March 8 the Ninth U. S. Circuit Court of Appeals, in San Francisco, heard the arguments in the case of Minerals Separation v. Butte & Superior, and in our next issue we shall publish a description of the proceedings. It is probable that we shall also publish a part of the brief on each side, believing that arguments and briefs alike will interest the large number of our readers that are not indifferent to the litigation over the patents controlling the use of the flotation process. No modern metallurgical process has found so wide an application as flotation, therefore the decisions of the various courts, particularly that of the U. S. Supreme Court, have been awaited with an anxiety far from academic. It is of the utmost importance to the mining industry to know, as finally it will, whether it is to continue under tribute to a patent-mongering company that has shown an overbearing spirit, or is to be free to proceed with the use and improvement of a method of milling relatively so simple and cheap. We are prejudiced in the matter, as our readers are aware, and our prejudice is based on reasons that are neither personal nor commercial. We are partisans for the mining industry, which, we have become convinced, is threatened by a burdensome exaction and endangered by an unjustifiable imposition. We may say frankly that our own study of the history of the process, particularly the description by Mr. James Hebbard of the early work at Broken Hill, as published in our issue of September 4, 1915, and in the book 'Flotation,' together with hints and various items of information concerning the work done prior to 1905, has convinced us that Messrs. Ballott, Sulman, and Picard were not the 'discoverers' of the agitation-froth method of flotation. The 'discovery' was made, we believe, in the Central mill at Broken Hill between 1901 and 1903, that is, two or three years before the alleged discovery in the Minerals Separation company's laboratory in London, when a series of experiments, by varying the temperature, time, and proportion of oil, particularly the last, are stated to have led to the sudden recognition of the basic principle of flotation and prepared the way for the master patent. We believe that any one of three or four men, among them Mr. Hebbard, and others whom we have definitely in mind, could give testimony that would prove our inference that the wonderful discovery of March 1905 was merely a camoufleurant device to establish an invention the principles of which had been known and demonstrated in the Central mill at least two years earlier. Those that could give testimony to this effect were formerly employed by the Minerals Separation people, or were otherwise associated with them, so that their personal loyalty conflicts with their public loyalty, to wit, the wish to serve the profession and the industry. They could be subpoenaed, of course, but an unwilling witness is proverbially dangerous, and we regret greatly that, for this reason, the truth, and the whole truth, about the origination of the agitation-froth process is withheld. Next, as we are reviewing the litigation on the eve of another critical decision, we venture to express surprise at the failure of the defence to make use of the facts of the Elmore vacuum process. Messrs. Jackling, Channing, and their associates bought the American rights to the Elmore vacuum process in May 1915, for only $50,000, but they have done nothing to develop it, although it antedates Minerals Separation's basic patent, No. 835,120, by a year and involves the use of a diminished proportion of oil. If they had expended as much ingenuity in developing the vacuum process as they did in circumventing 835,120 they could, ere now, have evolved a successful method of milling that might have put Minerals Separation out of court, for, as a matter of technical science, we know now that the various suppositions on which 835,120 was based are illusions. There is no 'critical' proportion and there is no need for a special kind of violent mechanical agitation. Apparently the controllers of the big copper companies feared to place themselves in the hands of the Elmores, who might have proved as exacting as their competitors, but the fact remains that the American courts have been allowed to ignore the Elmore vacuum process, in which as little as 0.15% of oil has sufficed to give commercial results, whereas the establishment of this fact ought to have gone far to invalidate the claims of Minerals Separation. Even now it seems feasible for the holders of the rights under the Elmore vacuum process to bring suit for infringement against Minerals Separation, provided that the Elmore method is developed to a successful milling operation on the ore from an American mine. Here we must lay emphasis on the fact that the British and Australian litigation between the Elmores and Minerals Separation was concerned with the older bulk-oil patents of Elmore and not with his later vacuum process, which used air rather than oil and was never made the crux of any lawsuit between these protagonists. The introduction of the bulk-oil suits into the record of the recent trials only confused the issue as between Minerals Separation and the supposed infringers in this country. Looking back, and with the wisdom that can be shown when writing last year's almanac, it would appear to us that the case against Minerals Separation has been handled badly; they have had the benefit of more than the 'rub of the green'; but we expect to see the issue contested henceforth with more psychical intuition, for when all is said and done, judges are human, they are pharaohs not sphinxes, and their methods of ratiocination have to be anticipated by learned counsel.



Alaska Juneau

The Editor:

Sir—In your article on the Alaska Juneau enterprise and its disappointments, in your issue of February 9, there are several misstatements, and, knowing that you wish to publish only facts, I take this opportunity of calling to your attention portions of the article that are untrue and misleading.

In your discussion of the allotment of interest in Mr. Bradley's Alaska Juneau contract, you stated:

"Another third to the San Francisco Exploration Company, a partnership consisting of Messrs. J. H. Mackenzie, M. L. Requa, and F. W. Bradley. The allotment of these participations, we believe, was prompted by motives of loyalty and friendship, not with the idea of spreading the risk."

The facts are that the San Francisco Exploration Company was incorporated in 1907 with 300,000 shares at $1 each. The cash paid-in capital amounted to $261,-255 and was derived from the sale of 15,000 shares in the Nevada Consolidated Copper Company. F. W. Bradley, M. L. Requa, and J. H. Mackenzie each contributed 5000 shares. Prior to the date of the incorporation, and before Bradley, Requa, and Mackenzie had become jointly interested in mining ventures, Mr. Requa was the means of putting both Bradley and Mackenzie into the Nevada Consolidated, which proved a very profitable venture. With the profits derived from this source was laid the foundation of the San Francisco Exploration Company. Afterward, as money was needed, each of the partners contributed to this company and each participated in many ventures, some of which were profitable and some otherwise. It was the duty of each of the partners to offer anything he might discover or procure in the shape of oil or mining ventures to the San Francisco Exploration Company, and motives of loyalty and friendship had nothing to do with it. Further on you state:

"Mr. Bradley strongly opposed a public flotation" * * *. "Under pressure of the wishes of his two immediate associates, Mr. Bradley also consented to a flotation."

For several months prior to the flotation, the Alaska Juneau was borrowing money and becoming further involved in debt. At the time of financing it owed $600,-000, and everybody connected with the company was concerned, including Mr. Bradley, as to how we were going to carry on the work and pay off the loans. At a conference held on January 23, 1915, William H. Crocker, Wellington Gregg Jr., F. W. Bradley, M. L. Requa, and J. H. Mackenzie being present, the financial condition was discussed. Mr. Bradley had just returned from New York, where he had refused an offer made by B. M. Baruch of a $3,000,000 bond-issue, convertible into shares at $8.75—the bonds not to draw interest before July 16, 1916. Mr. Crocker, the largest shareholder in the Alaska Juneau Gold Mining Co. at that time, asked on what grounds he had refused this offer. Bradley replied that Ogden Mills and he wished to retain their present percentage in the property and feared Mr. Baruch intended to get control of the shares and turn the management of the property over to the Alaska Gold Mines Co. Mr. Crocker replied that it was very dangerous for an enterprise to contract large call-loans and that it was almost an axiom that any enterprise in which this practice was pursued sooner or later would be sure to get into trouble. The property was looking exceptionally well at this period and the feed to the 50-stamp pilot-mill was averaging over $1.50 per ton; in fact, never before nor since has the Alaska Juneau looked as well as it did for the twelve months between May 1914 and June 1915, and any opposition to public financing that Mr. Bradley may have made was because he thought, as we all did, the property would come up to our expectations and was a good permanent investment, and of the further fact that he feared he might lose control.

In discussing the design of mill and the Requa circular, you state:

"Mr. Bradley was inclined to be cautious, the technical opinion at his disposal being divided as to the kind of crushing and pulverizing machines best adapted to the Juneau ore. Unfortunately early in 1915 he became ill, and in May he had to go to Honolulu to recuperate. During his absence Mr. Requa issued a circular, dated May 4, 1915, repeating that the mine contained 80 to 100 million tons of ore 'on which a profit of from 70 cents to one dollar per ton will be realized.' He suggested the probability that 240 to 300 million tons might become available. He referred to the Treadwell mines as having a lode of undiminished value and size down to 2000 feet below sea-level and predicted the continuity of the Juneau orebody to 'an indefinite depth.' He announced that George O. Bradley, who had been consulting engineer for the Utah Copper Company, was to design and supervise the erection of a mill having a capacity of 8000 tons per day."

On April 6, 1915 (more than two months prior to Mr.

Bradley's departure for Honolulu), he signed a contract on behalf of the Alaska Juneau Gold Mining Co. with George O. Bradley, representing Bradley, Bruff & Labarthe, wherein it was mutually agreed that the latter was to "undertake the design and superintend the erection of the 8000 tons daily capacity milling-plant for the above mining company, together with the necessary auxiliary departments, such as power-plant, crushing-plant, etc." In a letter to Mr. Requa, on April 6, 1915, Mr. Bradley said:

"You will be pleased to learn that we have today closed a contract with George Bradley, and his associates, for the building of our new mill in accordance with enclosed copy of contract itself, and in accordance with enclosed copy of my letter of today to Phil."

On the same day he wrote his brother, Philip R. Bradley:

"Mr. Mackenzie and myself have made a definite business arrangement with George Bradley to take complete charge of the designing and erection of our new milling plant, to have a capacity of 8000 tons per day. This means that George Bradley, or his representatives, will have charge of all experimental work in the present mill, and of all work of every kind in connection with the new rock-crushing and milling plant. You are to give George Bradley, or his representatives, every assistance and every facility that you see they may need or that they may have occasion to ask for."

On January 28, 1915 (over three months prior to Mr. Requa's circular), Mr. Bradley, in a letter to Mr. Crocker, made the following statement:

"The mining chances below the Gold Creek tunnel promise an addition of twice as much tonnage of the same value as I believe the vein will yield above the Gold Creek tunnel. These mining chances are based upon the fact that in a parallel vein two miles away on Douglas island the orebodies (of a higher value per ton) are now being mined at a profit from a depth of 2000 ft. below sea-level. At this depth below sea-level, the Douglas island orebodies still hold their size and average values."

In the circular of May 4, 1915, Mr. Requa merely quoted Mr. Bradley's own statements regarding the engagement of George O. Bradley and the probable chances of tonnage and profits below the Gold Creek tunnel. In your comments on the foregoing you state:

"Shortly after this optimistic announcement the didectors, in Mr. Bradley's absence, gave full authority to Mr. Mackenzie, as consulting engineer, with instructions to do whatever was necessary to expedite the preliminary mine work and to design and erect a mill of 8000 tons capacity. Two years later, on March 31, 1917, the new mill was ready to start. At the end of May, Mr. Mackenzie relinquished his duty as consulting engineer."

On April 6, 1915 (more than two months prior to Mr. Bradley's departure for Honolulu), he wrote the following to Mr. Requa:

"You will also be pleased to learn that I have made a definite business and mutually satisfactory arrangement with Mr. Mackenzie to act as exclusive consulting engineer for the company beginning 1st inst."

Early in June 1915, Mr. Bradley was preparing to go to Honolulu, and on June 4 the board of directors of the Alaska Juneau company passed the following resolution:

"Resolved, that pending the return of F. W. Bradley from Honolulu, and thereafter until he shall have resumed the active personal direction of the affairs of this company, Mr. J. H. Mackenzie, its consulting engineer, is hereby authorized and instructed to do and perform all acts necessary to the development and equipment of the company's mine for the output of 8000 tons of ore a day and to further do and perform all acts necessary in connection with the design and erection of the 8000-ton daily capacity mill already provided for."

The resolution shows on its face that it was only passed pending the return of Mr. Bradley and in order to carry on the business of planning a mill and further developing the mine during his absence. The authority was not given Mr. Mackenzie during Mr. Bradley's absence, or without his consent. On the contrary, the resolution was passed because Mr. Bradley had given notice that he was going to Honolulu to benefit his health and did not wish to be troubled with business affairs during his absence.

It is to be regretted that the capacity of the ball-mills has not come up to expectations, but, when the type of mill was under discussion, all available information indicated that ball-mills were a success and especially efficient on coarse feed of minus 3½ inches, making one easy step and eliminating stage-crushing. In Alaska Juneau practice owing to the toughness of the metagabbro and the large flat pieces of slate that pass the coarse crushers the capacity of the ball-mills is greatly reduced. The installing of rolls between the coarse crushers and the ball-mills, thereby reducing the ball-mill feed from minus 3½ inches to minus ¾ inch, will undoubtedly bring the mill up to its intended capacity of 8000 tons daily and, in addition, will reduce the load on the ball and tube-mills, ensuring grinding to proper fineness, and increasing the percentage of recovery. This intermediate crushing will add to the mill cost not to exceed 5 cents per ton.

At the present time the total cost of mining, transportation, and milling at the Alaska Juneau is about 65c. per ton, which is somewhat lower than the cost at the Alaska Gold. To say that the "mill as it stands is a failure" is not true; neither is it just to the shareholders to point to the mill as the cause of all the Alaska Juneau disappointments. The principal trouble with Alaska Juneau is that the ore milled during the year 1917 did not contain sufficient gold. For months prior to and after the financing of the company the unsorted ore crushed in the 50-stamp pilot-mill assayed about $1.45 per ton and over 200,000 tons of this grade of ore was milled. If the Alaska Juneau plant were now running on this grade of rock the company would be making a good profit; but such is not the case. If the mistakes made in the estimates of gold contained in the ore

and in the design of the mill were honest ones, then it is ridiculous to say that either the public financing or the type of mill were forced upon Mr. Bradley.

Mr. Bradley has been manager of the Alaska Juneau property for over sixteen years, has employed all the superintendents that have operated the property during this period, and the hand-sampling and the mill-runs have all been done under his direct instructions; therefore, he has been in a position to interpret these results as well or better than his associates. The company records show that he was not absent when the consulting engineer, or the firm of Bradley, Bruff, and Labarthe, was employed, but signed the contracts himself. He, personally, signed each and every contract for mill-machinery, the power-plant, and building-material. When he returned from Honolulu, there was not a single drawing of the mill finished, or a contract let, and he had ample time and authority to change the program to stamp practice, rolls, or any other type of mill that he wished.

In May 1917, I relinquished the salary attached to the position of consulting engineer for the Alaska Juneau, but did not relinquish and had no intention of relinquishing the duties of the position, and since then have, at all times, tried to assist in solving the difficulties met with in starting the new mill. Between the 5th and 10th of each month, Mr. Bradley receives from his brother, P. R. Bradley, the manager at Juneau, a cable giving the details of the previous month's operations. This information is sent out to a few favored shareholders, but since October 1917 Mr. Bradley has not seen fit to give the board of directors this early information until it appears in the manager's monthly report, which comes to the directors from 60 to 90 days later. If Mr. Bradley has assumed all the responsibility of the management of the Alaska Juneau company, it is because he wishes to do so and not because his associates have not been willing and ready to assist him.

J. H. Mackenzie.

San Francisco, February 28.

Sampling Diamond Deposits

The Editor:

Sir—I have read, with much interest, the discussions appearing during March, April, and May in your paper on the sampling of ore deposits of low grade. Among these a peculiarly ticklish problem is presented by diamantiferous pipes. According to the value of diamonds one admits generally that a 'pipe' is interesting if it contain 5 carats per 100 loads and that it is exploitable (for diamonds of an average value) if it contain 10 carats per 100 loads, these limitations being equivalent to 1 and 2 grammes respectively per 30 metric tons. The figures are the extreme, and if one regard the influence of the size of the diamonds and of their erratic distribution in the kimberlite one perceives how difficult and delicate a problem is presented to the engineer.

In Katanga (Belgian Congo) there have been uncovered up to date 25 pipes of kimberlite penetrating, like punched holes, the horizontal beds of the Kundelunga series, of the same age as the Karoo. These pipes were sampled in two ways: (1) On some of them one opens paddocks and treats in the rotary concentrators the whole of the tonnage extracted, varying from 200 to 1000 tons. Several small diamonds, some of 2 and 3 carats, have been collected. This sampling evidently is irrational and does not justify any conclusion except as to the core or as to the paddocks over the pipe; (2) in other places there has been adopted the system of sampling by a network of square meshes of 100 metres per side, with sampling pits (2 m. in square section) in the centre of each mesh. Unfortunately one is limited to a superficial sampling barely entering the 'blue ground,' and only 50 to 70 tons of material (yellow ground and blue) can be treated per pit. This method of sampling, distributed systematically over the entire surface of the pipe, is rational, but can one, with the small quantity of ore treated and the slight thickness of the slice removed, infer therefrom the value of the deposit?

The diamantiferous pipes belong to that class of deposits in which ordinary sampling, based on small quantities of ore, does not permit one to draw definite conclusions. I would be glad to have your advice, so competent, concerning the sampling of this type of deposit of small extent at the surface, low in grade, erratic in distribution, and unequal in value, based on the size and quality of the mineral sought.

F. F. Mathiez.

Rungu, Belgian Congo, October 12, 1917.

[We have taken pleasure in translating this letter, written in French. We shall apologize to Mr. Mathiez if we have failed to give his exact meaning. Despite his compliment, we do not feel competent to advise him specifically, but, knowing that Mr. Gardner Williams is in San Francisco, we shall ask him to express his opinion. —Editor.]

Blister copper, says Lawrence Addicks in 'Metallurgical & Chemical Engineering', as produced directly by the converter, does not make good anodes, and with few exceptions it is further refined in a special furnace, so as to reduce the work of the tank-house to a minimum. In principle the complete refining of copper involves (1) the oxidation of all elements more base than copper, removing them by slagging or volatilization, leaving only silver, gold, and the platinum group alloyed with the copper; and (2) the oxidation of the copper at the anode, leaving the noble metals in the slime. In the first stage an air-blast oxidizes some of the impurities directly, along with some of the copper. The Cu_2O formed dissolves in the bath, reacting with elements that have a greater affinity for oxygen (O_2) than does copper, thus liberating an equivalent amount of the copper. The basic oxides are slagged while the excess of Cu_2O is reduced by poling.

The Kansas-Oklahoma-Missouri, or Komspelter, Zinc Region—II

By T. A. RICKARD

THE MINES. My first visit underground was made at the Netta mine, of the Picher Lead Co. Descent in a bucket to a depth of 270 ft. brought me to a large open stope 12 to 30 ft. high. It was like dropping through a hole into an underground cavern. The shaft had been cribbed until hard rock was reached, at about 60 ft. from the surface; the stopes were not timbered; the mine, like rock being cemented by brown zinc-blende. On other faces coarsely crystallized galena was to be seen in patches. The ground was wet, but the water was underfoot, having been drained by adjacent mines down to the working-level. On returning to the surface the bucket, or 'can,' whirled around so much as to cause one of our party to become giddy; it is possible that a tenderfoot



A CHARACTERISTIC STOPE, SHOWING MACHINE-DRILL AT WORK, ALSO 'CANS'

a real gentleman, had no visible means of support except such as nature provided. Pillars 20 ft. thick had been left at 35-ft. intervals and arranged zigzag. A bed of chert made a safe roof. That reminds me of two greenhorns that were set to work in a neighboring mine where timber is used; they noticed it and wanted to quit forthwith; on being asked for a reason, one of them exclaimed, "That drift is dangerous, they've got it propped up with wood." To which one may remark that the underlying idea was not far wrong, in so far as rock is a better support than wood.

The ore of the Netta mine was in brecciated chert, the might be endangered by loosening his hold of the rope under such conditions. The Netta mine is named after the Indian woman that owns the ground. Five acres have been stoped and 79 acres are to be under-cut in the same way. Two shafts (each 5 by 7 ft.) are in operation. The impression made by one's first visit is that the mining is delightfully simple; the ore is easy to follow; the ground stands well; and the shallowness of the deposit facilitates exploitation.

The next mine to which I went was the Underwriters No. 1, where stoping was in progress at a depth of 151 ft. Here the mineralization along lines of brecciated rock,



KITTY BEAVER SHERIDAN ADAMS

or 'watercourses,' had formed a series of lodes separated by intervals, 8 to 30 ft. wide, of barren chert. Half-formed crystals of light-brown sphalerite, or 'resin-blende,' lay on the fracture-planes of the chert and also on the calcite that lined the fractures. A vug, or geode, of clean blende might be seen ten feet from a patch of coarse galena, filling a cavity.

The third mine that I visited was the Woodchuck. Here the shaft was 150 ft. deep, cribbed nearly all the way, down to 125 ft. from the surface. The first observation to be made on arrival underground was the black streaks of 'tar' dripping over the faces of the stopes. Such a sight is not uncommon in the district. The so-called tar is an asphaltic oil, containing only 8% solid asphalt. The Woodchuck mine is 200 ft. from Tar creek, a small sluggish stream the name of which originates from the scum of oil readily observed on the surface of the water. The tar seeps through the roof of chert, suggesting permeability. Not long ago a pocket of tar was cut in the stopes and smeared the broken ore in such a way as to make a miserable mess in the mill. The question arises: if the ore naturally contains tar, and if it be mixed with other ores in the district free from tar, might not enough tar be present in the mill-feed to facilitate flotation? If this natural tar were present in a proportion suitable for a frothing-agent, would Minerals Separation or any other patent-owning corporation be entitled to collect royalty on the use of this metallurgical ingredient? Also, does not the tar in the mill-feed cause a loss of valuable mineral, by floating the slime when concentrating in the jigs and on the tables?

The superintendent of the Woodchuck, C. W. Ritter, took me down the No. 1 shaft. The faces of ore showed the 'jack,' or blende, 'frozen' to the flint; it is not easily sorted, whereas the galena occurs in pockets or patches, so that it can be broken clean. I saw nine-inch cubes of galena, and Mr. Ritter told me that he had obtained many crystals 12 inches cube. He shipped one carload (50 tons) assaying 84%. Occasionally chambers, or big vugs, are penetrated in the course of stoping; these may be lined with crystals of galena, providing a sight of rare beauty. Returning to the surface, we descended through the No 2 shaft, which is 212 ft. deep, to another stoping area at 265 ft. Here the ore-bearing chert was darker and the mineral was chiefly resin-blende along the bedding-planes where these had been crossed by nearly vertical fractures. The ore-bearing rock was capped by gray chert. The light from the lamps was reflected from the facets of galena and blende, also from the dripping tar, affording a brilliant display.

Mining and Milling Practices. This has been essentially a 'leasing' region. Lessees are proverbially short-sighted, for a sufficient reason; they gut a mine. As soon as the ore runs below grade and the royalty threatens to kill the profit, they quit, and go elsewhere in search of a better opportunity. Joplin has been a synonym for the precarious in mining. When other districts failed to give remunerative employment the miner of the Middle West could always go to Joplin and get a lease on a 5-acre patch. All that he needed in the way of equipment was a one-lunger 8 by 8 engine taking steam from a 10-hp. boiler, with a 1000-lb. can at the end of a $\frac{5}{8}$ rope. The boiler was mounted on top of a derrick, so that the hoist-man could attend to the boiler as well as perform more customary duties. The shaft was a 5 by 7 hole lined with "kindling wood and matches," an an old-timer phrased it, meaning anything on which he could lay his hands. It was a rough and ready equipment and a short-lived operation, but it had the merit of being economical and of being adapted to the immediate purpose, which was the extraction of small bodies of low-grade ore at a shallow depth. As for his mill, when the lessee had to build one, he did not draw a plan, "he just went out and built it." The Joplin mill became a synonym for cheap and successful crudity. Classification was ignored. Rough jigging, sometimes done by hand, sufficed. If it did not, then the rough concentrate was re-jigged; that was all. As for marketing the product, that was equally simple. The lessee placed it in a bin until such time as the buyer, the representative of some smelter, came along and sampled it by mere inspection of a handful, as an expert buys tobacco. Only within recent years has buying been based on an assay. In a day or two he got a bid from this buyer and from others that had tested his product in a similar way. The mining was simple, for it in-



MC CONNELL LUCKY JUNCTION SKELTON WOODCHUCK CROESUS

volved no timbering, thanks to the fact that the ore, about 8 ft. thick, was covered by a bed of flint that became the roof of the stope, which was only 100 to 200 ft. below the surface. The milling was simple because the zinc-lead ore consisted of coarsely crystalline blende and galena, in the proportion of 5%, in a hard chert that was easily detached from the valuable mineral; and, best of all, the Joplin miner was his own master, he worked with one or two partners, he was independent of unions and



A PILLAR TO SUPPORT THE ROOF

of corporations; he was an American, not a Dago or a Bohunk; he could look any man in the face and tell him to go to hell!

The mills give a first impression of sloppiness and inefficiency. The character of the ore-dressing practice has been affected by the uncertainty of the mining, for operations in the older districts of Joplin and Webb City were dependent upon relatively small reserves of ore and upon a market of the most uncertain kind. A visitor might



A SHAFT, SHOWING UNTIMBERED OPENING

come to Joplin and find seven or eight hundred small mills at work in the surrounding country and if he returned six weeks later he might find half a dozen of them idle or moved elsewhere. A look of impermanence characterizes the older mill-buildings; they suggest that

their owners take short views of life economically. The interiors are dark and dirty. Boys seem to hang around in a desultory way. At Carterville I watched a man with shovel and wheelbarrow removing concentrate ten yards; soon a two-horse wagon came with two men, who shoveled the concentrate into the wagon. It looked unmethodical and unintelligent, but it was explained to me that the buyer's men did the second shoveling into the wagon and that this was an old custom, the idea being that during the transfer of the material it underwent mixing, so that a better sample could be obtained when it was shoveled, for the third time, into a railroad-car and spread upon the floor so that a number of auger-samples could be taken. It would seem as if the buyer and seller could unite in devising some more economical method. Systematic weighing, sampling, and assaying are conspicuously absent in the milling practice, because the cost of such checks, I was told, would equal the whole cost of milling. *Credat Judaeus Apella.* The assay of the tailing, as a check on the milling, is inadequate because it may record the presence of non-recoverable mineral—the fine flaky blende—nor does it include the slimed sulphide that floats away. Flotation might be used as a check on mill-losses, if for no other purpose. Without being supercilious, it would seem as if an effort to keep the machinery in better order, by maintaining everything ship-shape, and pitching the mill-work on a higher key of attention, might reduce the cost of milling, at least in such mills as I happened to see at Carterville. In a mill in the Wisconsin zinc district where 6 men used to be employed to treat 5 tons of ore, now 3 men suffice to attend to the milling of 50 tons. One can never tell until one has tried.

Undoubtedly the leasing system is not stimulating to innovations. The short life of the enterprise is a deterrent to experimentation. On the other hand, it intensifies the mining operations. The owner of the ground, originally a poor farmer, may not have the money to mine himself nor perhaps the experience warranting him in risking a mining venture. Therefore companies are organized to lease, to open up the ground, to prove its possibilities, and then to sub-lease it in small tracts. One bad result is the cumulative increase of the royalty, which may rise to 25%. Formerly it was 10% straight; now it is based on a sliding scale regulated by the prices of zinc and lead. This helps the lessee to weather the bad times. On the whole, one may question whether the leasing system is well adapted to low-grade mining; it is far better suited to rich ore, such as that of a precious-metal mine.

In criticizing the local milling practice, one must remember that the matrix of the valuable mineral is extremely hard—flint—and that comparatively coarse crushing (35-mesh) suffices to separate the proportion (60%) of mineral that is recovered in the concentrate. Only 5 to 15% of the mill-pulp, in its usual state, is suitable for flotation, owing to the coarseness of the grinding and the non-sliming character of the ore. At the Woodchuck mill, for example, C. C. Burger (Pennsylvania '90) informed me that the total cost was $1.75 per ton of ore and $25 per ton of concentrate; the ratio of concentration being 12½:1, the recovery 8% in a concentrate containing 60% of combined zinc and lead as sulphides. The tailing contains 1.5% combined zinc and lead; allowing for loss in slime, the total loss would be at least 2% of combined zinc and lead. The recovery is estimated at 70%, but this is considerably better than the average of the district. The flow-sheet of the Woodchuck mill is typical of the best local practice. From the Blake crusher the ore goes to Cornish rolls and then to trommels, yielding a ⅜-in. product. The undersize from the trommels goes direct to Cooley 'rougher' jigs having five compartments, each measuring 36 by 48 inches, with screens having openings varying from $^1/_8$ to $^1/_{12}$ inch. The middling, or 'smittem' (another local term), from these jigs goes to a 7-compartment 'cleaner' jig and is not re-ground. The tailing, or 'chats', recovered from the last three beds of the rougher jigs is re-ground and passed through a trommel having ⅛-in. openings to be treated on a separate jig together with the sand from the last two hutches of each rougher jig. The overflow from the end of these 'sand' jigs, with the exception of the cleaner tailing, which is treated on the sand jig, passes over dewatering screens having 1½ to 2-mm. apertures. These undersized products are then diverted to settling-tanks, the overflow from which passes to a Dorr thickener of 50 ft. diam. on their way to a set of 16 tables. The product from the settling-tank is screened to 1½ mm. by a trommel, the oversize being re-ground so as to pass through this trommel, while the undersize is divided and then treated by hydraulic classifiers, producing six different classes, the coarser product going to six Arbuthnot tables having the Overstrom motion, while the finer material goes to six Wilfley tables. The product of the Dorr thickener is treated by four Deister-Overstrom slime-tables.

The recovery of zinc in the form of concentrate ranges from 55 to 65%. C. A. Wright says[4] that the recovery of 68.6% at a mill discussed by him, is "somewhat higher than the average zinc-recovery throughout the district." At the mill discribed by him only 2.31% passed a 65-mesh screen. This represented 44.44 tons of pulp containing 5.24% zinc, or 2.328 tons of metal. The overflow from the settling-tanks contained 34.73 tons of solid, assaying 5.01%, making 1.74 tons of zinc. Thus 79.17 tons of pulp, assaying 5.14%, and containing 4.068 tons of zinc, would be available for flotation. He concludes that an additional saving of 10.6%, bringing the total recovery to 79.2%, might be made. The main difficulty, of course, is the fine grinding. The flinty matrix renders such work unusually costly. Experiments have yet to be made in order to ascertain the kind of machine best adapted to the work. The demand made by the process-mongering company, Minerals Separation, namely, 2% on the value of all the products of a mill, however produced, is a decided deterrent to the general use of flota-

[4]'Flotation of Lead and Zinc in the Joplin District,' M. & S. P., Oct. 20, 1917.

tion. Six flotation units were at work at the time of my visit, last October, in plants having a capacity ranging between 25 and 100 tons per day. For the present the best prospect seems to be offered by the re-treatment of the dumps in the older localities, such as Joplin and Webb City. This material can be jigged and then re-crushed to 60 – 80 mesh, the product going to the flotation-cell. A test made by J. M. Callow, at Salt Lake City, showed 456 units of zinc in the original sample; when this was jigged it yielded a concentrate containing 380 units. After grinding to 60-mesh a recovery of 320 units was obtained by flotation. Thus 69% of the zinc was recovered in the form of a 60% concentrate.

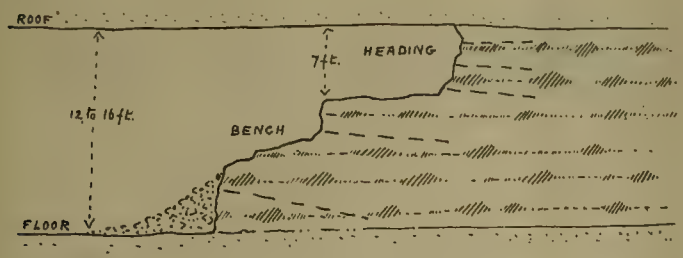


FIG. 1. SECTION OF A STOPE

A typical enterprise in Oklahoma may be described. A unit of area is 40 acres. To test this tract it would be necessary to do 10,000 ft. of drilling at $1.50 per foot, making $15,000. In order to mine systematically, two shafts, each 260 ft. deep, would be sunk at $6000 apiece. With incidentals the shafts would involve an outlay of $15,000. Thus the preliminary work would entail about $30,000, excluding the cost of pumping, which is too variable to allow of averaging. Occasionally a flow of 3000 gal. of water per minute has to be overcome; this may require six months of pumping to lower the water-level so as to permit of comfortable mining; the maximum cost may run to $45,000. However, this item is of decreasing importance and is now rarely burdensome because the water-level in the district has been depressed to the ore-horizon, or just below it, along several of the 'ranges' or groups of 'runs,' in other words, the main lode-channels.

Here I may refer to an incident of mine-drainage. In 1911 T. F. Lennan (Tech. '99) was superintending the sinking of a number of shafts on the Miami Zinc & Lead Co.'s ground. At 260 ft. he placed a pumping equipment that drained the whole Commerce sub-district. The level of ground-water was at 200 ft. He sank the main shaft in shale and extended a drift to within ten feet of the ore in dry ground under the shale-chert contact. There he built a cement dam preparatory to penetrating the water-zone along the contact. He made an iron door with suitable valves in the dam. Upon penetrating to the wet ground the water flowed at the rate of 2000 gal. per minute, draining the neighboring ground immediately. Mr. Lennan asked his neighbors to contribute to the cost of the pumping. They were unwilling. Thereupon he closed the valves in his iron door and stopped the drainage. Soon they 'came across' and paid $100 per month toward the expense of pumping—12 of them. This pumping plant drained three miles each way along the Miami fault.

The mine having been started, there comes the need of a mill. One of 600 tons capacity per 24 hours will cost about $80,000. This will cover the expense for a complete plant, including power equipment, but not flotation and its attendant royalty. Stores to the value of $15,000 will be needed when starting the mine and mill. The drilling and shaft-sinking, as we have seen, will cost $30,000; the hoist, boilers, head-frame, compressor, drills, track, and accessories will cost $50,000. The total outlay is $175,000; it may be taken as ranging between $150,000 and $200,000.

The time required to establish a going enterprise may be inferred from the record of the White lease of 80 acres. Drilling was started on October 10, 1916. By March 1, 1917, a reserve of 600,000 tons had been proved. A start to build the mill was made on February 28 and the mill was running on May 2. The mill has a capacity of 750 tons per 24 hours, it being necessary to be specific because many of the mills do not run full time. This record, made under the management of Persifor G. Spilsbury (Lehigh, '05), is probably above the average for speediness, but it will serve as an example. The enterprise was started and put in full swing within seven months.

To return to our 40-acre lease. The ground should yield 40,000 tons of concentrate averaging 60% zinc and lead. The value of this product in the future involves some guessing. In the summer of 1915 a maximum price of $135 was paid for 60% zinc concentrate and in the summer of 1916 a maximum price of $130 per ton was paid for 80% lead concentrate. In October 1917, when I made my investigation, $85 was paid for the lead and $75 for the zinc concentrate. A large tonnage of 60% zinc concentrate carrying 6% lead was being sold for $62 per ton. The concentrate is placed on the market and sold to the smelter. What should it be worth in the future? When I asked three of the best-informed tech-

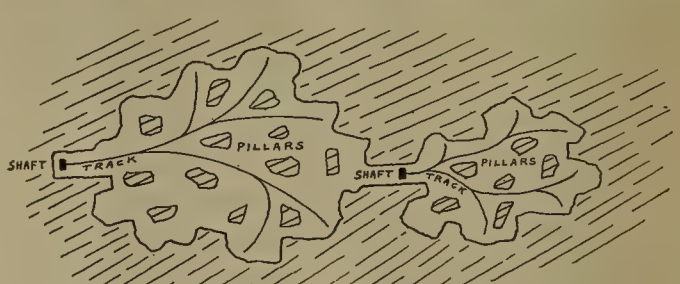


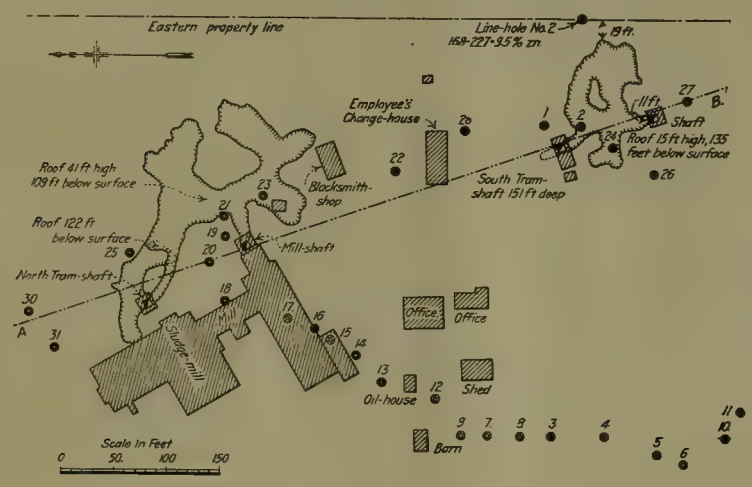
FIG. 2. PLAN OF STOPES

nical men in the district, one said impatiently "Not a damn!", but he revised his opinion and said $60 per ton; the second said that $75 was a fair expectation; the third thought that the minimum would be $40. Upon further discussion it was agreed by those present that $55 was a good basis for an estimate of future production.

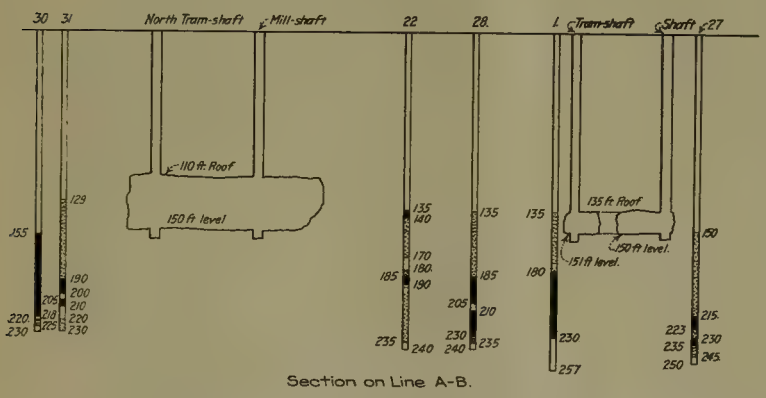
During normal times—before the War—on a 7% reconcentrate was $20 when the royalty was 10%. The market price of concentrate was $45 and the cost of mining and milling $1.10 per ton. The yield was $24.75 per ton, thus:

Market price of concentrate	$45.00
Royalty 10%	4.50
	$40.50
14⅓ tons of crude ore at $1.10 per ton	15.75
	$24.75
Deduct amortization of ore-reserve	4.75
	$20.00

Therefore the 40-acre tract should yield 40,000 tons of 60% zinc concentrate, and 8000 tons of 80% lead concentrate at a combined profit of $20 per ton, making $800,000.



Plat of Mill-site.



Section on Line A-B.

FIG. 3. PLAN AND SECTION OF WOODCHUCK PROPERTY, SHOWING DRILL-HOLES AND STOPES

Between July 1916 and July 1917, when a war supply was being collected, the market for concentrate averaged $73 per ton. On a 5% recovery it would require 20 tons of ore, at a mining and milling cost of $1.80 per ton, to make a ton of concentrate. The royalty, usually on sublease, would be 15% instead of 10%. Thus the estimate would be:

Market price of concentrate	$73.00
Royalty 15%	10.95
	$62.05
20 tons of crude ore at $1.80 per ton	36.00
	$26.05
Allowance for depletion	5.00
	$21.05

Thus, thanks to the higher price of the metals, the profit was even better than in normal times.

The post-war profit per ton on a price of $55 for 60% concentrate should be:

Market price of concentrate	$55.00
Royalty 15%	8.25
	$46.75
20 tons of crude ore at $1.30 per ton	26.00
	$20.75
Allowance for depletion	5.00
Profit	$15.75

Most of the local output is sold to the United States Steel Corporation's zinc plants at Denora, Pennsylvania, and Cherryville, Kansas. These take 3000 tons per week. Matthiessen & Hegeler, at La Salle, Illinois, take about 1000 tons each week. An equal amount goes to the Illinois Zinc Co. at South Chicago. The American Metal Co. buys 2500 tons weekly for its plant at Bartlesville, Oklahoma. The Grasselli Chemical Co., in West Virginia, is another important buyer. The American Zinc, Lead & Smelting Co., at St. Louis, is in and out of the market irregularly. The United States Mining, Smelting & Refining Co. owns a group of small smelters in Oklahoma and Kansas; these buy a good deal of the local product. It is estimated that 21,000 retorts in the smaller smelters consume 7 tons of concentrate per retort per annum.

A good example of a winning enterprise is afforded by the Oklahoma Woodchuck, which is being operated by Mr. Burger as president for a company of New York capitalists. The lease of the 40 acres was acquired on April 25, 1917, for $200,000 cash and a 15% royalty, plus ten additional monthly payments of $15,000 each, making $350,000 in money. A 200-ton mill was on the ground and has been more than doubled in capacity since

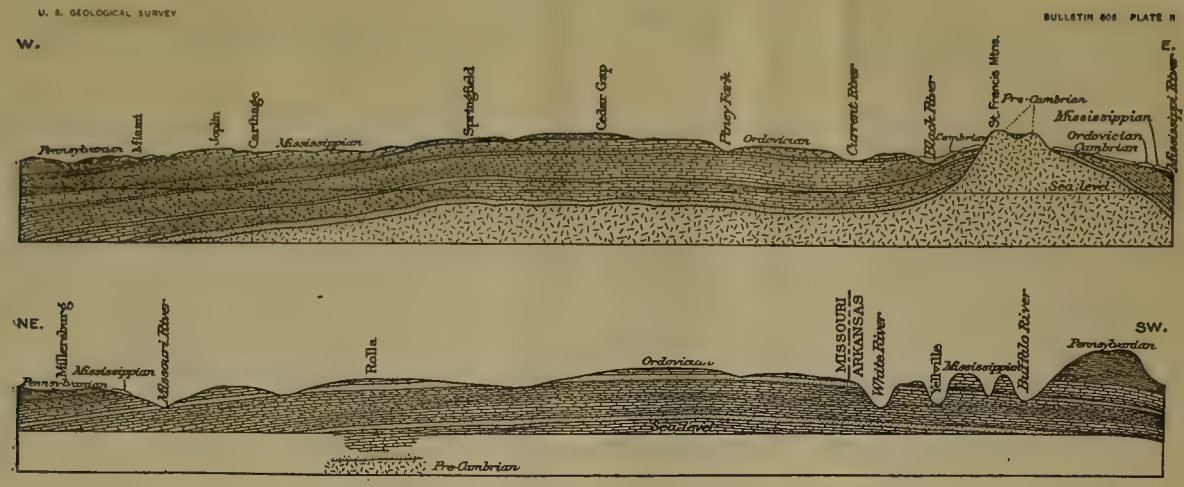


FIG. 4 GEOLOGIC CROSS SECTIONS OF THE OZARK UPLIFT.
After Buckley.

the purchase. The ground had been drilled at 31 points with results that indicated a tonnage of ore valued at several times the purchase price of the lease. This estimate has been confirmed by the work done during the summer.

On the accompanying plan and section (Fig. 3) are shown the drill-holes that justified the purchase of the Woodchuck property, also the mine-workings as they were last summer.

A 10-year lease on a 40-acre tract having at least two drill-holes in good ore is said to be worth $50,000. "Five holes in ore are worth $10,000 apiece" was the dictum of a well-informed operator. A few examples of actual deals will be interesting.

1. 40 acres, 30 drill-holes, 1 mill, 2 shafts, 15% royalty. Price $30,000.

2. 100 acres, 83 drill-holes, 3 mills, 5 shafts, 20% royalty. Price $600,000.

3. 180 acres, 45 holes, no mill, no shaft, 15% royalty. Price $250,000.

4. 560 acres on the outskirts of the district, 30 drill-holes, no mill, no shaft, 15% royalty. Price $100,000.

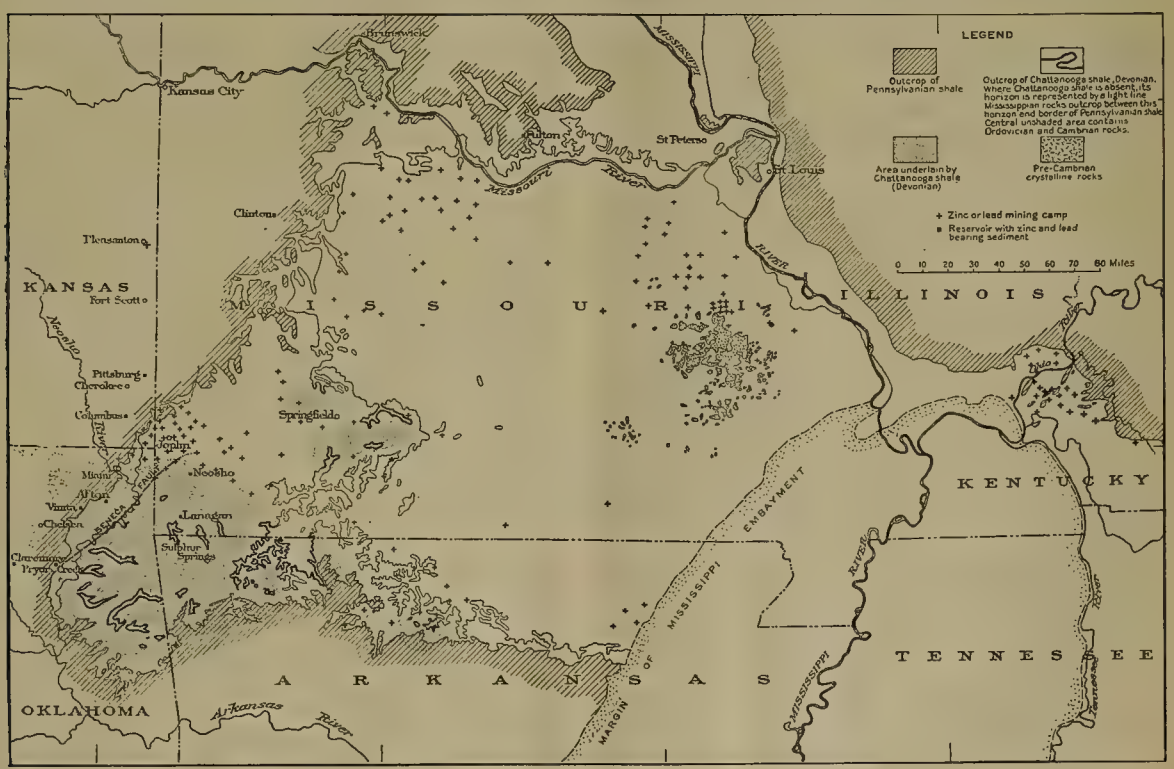


FIG. 5. MAP OF THE OZARK UPLIFT. U. S. GEOLOGICAL SURVEY

5. 20 acres, 9 drill-holes, no mill, 1 shaft, 25% royalty. Price $125,000.

6. 20 acres, no drill-holes, no shaft, 15% royalty. Price, $50,000.

7. 40 acres, 115 drill-holes, 1 mill, 4 shafts, 25% royalty. Price $1,000,000 flat.

8. 320 acres, in the heart of the district, 72 drill-holes, 3 mills, 9 shafts, 12% royalty. Price $1,250,000.

9. 300 acres, 350 drill-holes, 15 shafts, 6 mills and building 4 more, 7 to 12½% royalty. Price $2,000,000. This property is yielding 500 tons of concentrate per week, so that the owner (L. S. Skelton) is making about $1,000,000 net per annum.

In every case the mineral rights are held under a 10-year lease, subject to renewal, but as to that no assurance is given. It may be assumed that most of the operators expect to exhaust their ground within the decade.

The cost of existing activities in the Komspelter zinc districts may be estimated. It is probable that 1000 drills are[6] at work averaging two holes per month, 300 ft. deep, at $1.50 per foot. This represents $900,000. I am informed that 167 mills have been built and that 100 of them are running. Estimating that each group of mining operators owning one of these mills is spending an average of $15,000 per month, we get a monthly expenditure of $1,500,000. Thus the total annual expenditure now being incurred in the district is about $30,000,000. The mineral output in 1917 had a market-value of $36,000,000.

Ore Deposits. For the purpose of an article such as this, intended to give a general description of the region, it is not necessary to present much geologic detail. Viewed broadly, the rock structure is simple. The Komspelter zinc-mining region constitutes one of four mineral areas bordering the Ozark uplift, which is a dome of pre-Cambrian granite and other crystalline rocks thrust through a sedimentary series sloping from a maximum elevation of about 2000 ft. above sea-level to the plain, 1500 ft. lower, as shown by the accompanying cross-section (Fig. 4) borrowed from C. E. Siebenthal, whose study[7] of this region is accepted as authoritative. The tilting of the sedimentary rocks is marked by anticlinal folds and by faults, which together have served to give direction to mineralizing solutions. The chief structural features are the Joplin anticline, the Seneca fault, and the Miami fault, all of which are shown on the map accompanying my previous article. See also Fig. 5.

The characteristic ore deposit of the Joplin district is the 'sheet ground,' the name given to nearly horizontal seams of blende and galena lying between layers of flint. These seams range from a fraction of an inch to several inches in vertical series, so as to form a workable thickness of ore-bearing ground 6 to 40 ft. thick. The flint formation is known as the Great Falls chert; it lies between beds of limestone, called the Mississippian, and is overlain by the shale and sandstone beds of the Pennsylvanian series, all Carboniferous.

In the Picher and Commerce districts the surficial formation is the Cherokee shale, of the Pennsylvanian; this overlies the Chester sandstone and limestone of the Mississippian, resting upon the Boone chert and limestone, at the base of the Mississippian. The removal of the Chester limestone, by solution, has caused the sandstone to settle upon the Boone chert so as to cause the sandstone and the chert itself to be fractured and brecciated. In this breccia the zinc ore has been precipitated along channels of solution that constitute 'runs'. The ore is found at depths ranging from 90 to 200 ft. depending upon the dip, the faulting, and the topography. The rock sufficiently enriched to be 'ore' is from 15 to 50 ft. thick and is usually limited by beds that have resisted fracture.

The methods of mining in the Joplin district are simple.[8] In the first place the ore-bearing ground is nearly horizontal and from 2 to 20 ft. thick, so that it can be stoped for the full thickness by driving a heading under the roof and then blasting the bench that is made thereby. Fig. 1 is a rough sketch, showing the drill-holes in dotted lines, and also the ore, in pockets and seams. The roof consists usually of a bed of flint two or three feet thick. The stopes have the appearance of big cellars with bays made by the several headings. Fig. 2 is a sketch of a mine in plan, showing how pillars are left to support the ground and how the car-tracks reach out from the shaft. Pillars, 12 to 30 ft. thick, are left at intervals of 25 to 30 ft. Special care is taken to protect the shaft. The shafts—which are less than 300 ft. apart—have only one compartment, and are not provided with ladder-ways, the men ascending and descending in the 'can' or 'bucket'. The Joplin practice, as outlined above, is duplicated in the new Oklahoma zinc mines, for instance, as I saw it in the Netta. The ore is from 15 to 40 ft. thick. Where the ore-fractures and zones of brecciation are separated by intervals of barren rock, it is usual, of course, to leave these intervals intact for the support of the ground. The more nearly vertical arrangement of the ore, between hard beds of flint, causes the stopes to be high and narrower, but the general procedure is much the same. In leaving pillars, advantage is taken, as far as possible, of ore leaner than the average. Partly because of the thickness of the ore deposits, and partly because of the character of the roof, which is strong and will not break in the proper manner, it is not feasible to apply any modification of either the long-wall or the caving systems in these mines. The pillars at first are quite large in horizontal cross-section. After the ore has been followed to its limit in any direction the pillars are systematically robbed to the extent that the experience of the miners indicates as being safe.

[6] I am speaking of operations as they were in October last; since then the falling market has served to discourage prospecting.

[7] Bulletin 606, U. S. Geological Survey: 'Origin of the Zinc and Lead Deposits of the Joplin Region,' 1915.

[8] 'Mining and Treatment of Lead and Zinc Ores in the Joplin District, Missouri.' By Clarence A. Wright. Technical Paper 41, U. S. Bureau of Mines.

The absence of share-dealing is a marked feature of mining throughout this region. To one engaged in obtaining information it is a wholly pleasant feature, because there is neither the reticence nor the discounting of truth that follow the gambling and the mis-representation that are part of share-peddling. The mines are owned and operated by small groups and syndicates, for the most part, and even where a corporation controls property any speculation in shares is prevented by the failure to list companies working these zinc-lead mines. I was informed that so much money had been lost by the public in the Joplin and Webb City stocks that the brokers of the New York Curb Association decline to list the shares of mining companies in these and adjacent districts. A few unimportant companies are listed on the Kansas City curb. It is probable, however, that a stronger reason for the absence of share-dealing is the fact that mining operations are conducted under leases of relatively short periods, decreasing the equity-value of the properties, but producing the excellent result of causing attention to be concentrated on the exploitation of the ore deposits, not on the pockets of the public. In consequence of these conditions it seems to the visitor that the business is conducted on a most satisfactory basis. The local industry shows how mining can be done vigorously and successfully without the intoxicant that has impaired the economic health of many rich mineral localities.

THE complex nature of the platinum-bearing ores of the Boss mine, in the Yellow Pine district, Clark county, Nevada, according to Fred A. Hale Jr., has presented many difficulties, but after extensive experimenting, a process has been evolved which bids fair to prove successful in the extraction of the metals. Owing to the inaccessibility of the mine and the high cost of labor and reagents, it was decided to erect the plant at Los Angeles. A separate corporation, known as the Palau Metals Co., was formed, and this company, headed by C. A. Overmire, entered into a contract with the Boss Gold Mining Co. for the exclusive treatment of its platinum-bearing ores. A plant of 300 tons monthly capacity was erected. The ore treated in the plant averages about 7% copper, 4% bismuth, 1.0 oz. platinum metals (platinum and palladium), 0.75 oz. gold, and 3.0 oz. silver per ton. It is crushed to 8-mesh at the mine before shipment. The crushed ore is dumped directly into bins from which it is fed to a 4 by 5-ft. Herman mill, which reduces it to 80-mesh. The pulp is elevated by a Frenier pump to 14 agitating tanks, where sulphuric acid is introduced to bring the solution to approximately 2%. The pulp is agitated for about 14 hr., the solution then decanted, and the pulp washed with water. The acid solution, which contains practically all the copper of the ore, together with about 20% of the platinum content, flows to tanks filled with scrap-iron, which precipitates the copper as cement copper, this containing also the platinum content of the solution. The cement copper from the precipitating tanks is collected periodically and forwarded to a refinery. In order to recover the remainder of the platinum, together with the gold and silver, the pulp is treated with two successive leaches of calcium chloride, the sulphuric acid having been previously neutralized with lime. No details are available for the exact method used in precipitating the precious metals from the calcium chloride solution. The process involves no roasting and all solutions are applied cold. The inventors of the process claim that the operations to date indicate an extraction of approximately 92% of the copper, and 96% of the platinum metals, gold, and silver. Over 90% of the bismuth content is also recovered and forms a valuable by-product.

Alaska Gold

Rumors to the contrary, Alaska Gold is not contemplating a shut-down, although under the adverse operating conditions of the past winter, accentuated by an insufficient supply of labor, the property has not in all months been able to show proportional fixed charges earned. In addition to 750,000 shares, Alaska Gold has $3,000,000 6% bonds outstanding, semi-annual interest on which is due March 1 next. The amount of this semi-annual interest is $90,000. There is likewise no truth in the rumor that a consolidation with the adjoining Alaska-Juneau is contemplated. Beyond informal talks between interested parties on both sides some two years ago, no official consideration has been given to a union of the two properties. In respect to ore disappointments, the expected values in Alaska-Juneau have been quite as far below original expectations as have been those in the Alaska Gold property. The results for January at Alaska Gold, showing an average value of ore extracted of but 90.3 cents per ton, established a new low record, the previous low points being 92c. in November 1915, and 94c. in April 1916. These figures compare with an anticipated recovery, when the property was originally offered to the public, of $1.75 per ton. While the ore ran below 90c. per ton during the first 10 days of January, the headings in the final 10-day period averaged about $1.16. In view of the fact that under normal operating conditions Alaska Gold can do better than break even, the management will continue operations in the hope of running into higher-grade ore. A shut-down of the property would paralyze business conditions in the Alaska mining district in which it operates, besides throwing out of employment a large number of its own men. Until conditions, therefore, become more desperate than at present, operations will continue. It is needless to say that the disappointments at the Alaska Gold property have been a great blow to managing director D. C. Jackling, who, however, consoles himself with the thought that those who have followed his mining judgment in the copper investment field have done so well that they will perhaps be generous enough to take philosophically the Alaska Gold failure.—'Boston News Bureau.'

Specific Heat

By JOHN ROGER

The specific heat of a metal is supposed to be the amount of heat necessary to raise the temperature of one pound 1° F., as measured by the amount of heat required to raise the temperature of one pound of water from 62° to 63° F. This is right and proper in determining how much heat is required to raise the temperature of a given weight of metal so many degrees, but when we wish to compare the specific heat of one metal with that of another, it shows no relative proportion whatever, as may be seen by comparing the specific heats of the various metals given in the accompanying table.

Metal	Atomic weight	Specific heat	Weight cu. ft. lb.	Diamagnetic resistance	Tensile strength per sq. in. lb.	Melting temperature, F.
Nickel	58.7	0.109	548	59.97	80,000	3,560°
Iron	55.9	0.113	480	55.58	60,000	3,260°
Copper	63.6	0.095	552	52.44	34,000	2,390°
Platinum	194.8	0.032	1,347	43.10	50,000	3,660°
Silver	107.9	0.057	655	37.33	36,000	2,210°
Gold	197.2	0.032	1,200	38.40	20,000	2,432°
Aluminum	27.1	0.214	167	35.1	20,000	1,675°
Zinc	65.4	0.095	436	41.42	6,000	1,240°
Tin	119.0	0.056	458	25.64	5,000	902°
Lead	206.9	0.031	709	21.97	3,000	1,085°
Antimony	120.2	0.051	421	21.42	1,000	1,270°

The explanation is a simple one, namely, equal weights of dissimilar metals are not equal quantities; equal quantities should be measured by equal specific volumes. Weight is not a property of the matter we weigh, but is a relationship, and is dependent on the composition and condition of the earth, the attracting body. The earth attracts different elements with different degrees of intensity, similarly a magnet attracts different elements with different degrees of intensity, but the relative forces of attraction do not in either case constitute measure of quantity. The intensity of the earth's attraction, or the relative weights, do not in any way indicate the relative physical properties of the metals. To compare the specific heats of the various metals by quantities of equal weight is to compare altogether unequal quantities of matter. To say that one cubic inch of platinum and about eight cubic inches of aluminum are equal quantities, because they weigh the same, is absurd on the face of it.

When we add heat to, say, one cubic inch of iron, it acts to decrease the force of the atomic attraction, increasing the temperature, but the weight, or the atomic weight, has nothing to do with the case, because we are dealing with atomic relationship. Whether it is assumed that the increased temperature represents increased vibration, or represents an increase in the force of atomic repulsion, the change is produced in either case against the resistance of the force of atomic attraction, and has nothing to do with the weight of the material.

We estimate the strength of a metal by the square inch, and the square inch is a proportion of the cubic inch. So we estimate the strength of the metals by proportions of equal volumes. When we add heat to the metal it decreases the strength by overcoming its force of attraction, so the proportionate relationship between the different metals must be a volumetric one. The weight of a metal does not in any way indicate its force of atomic attraction. It must be evident that the specific heat of a metal is proportionate to the change produced in the force of atomic attraction, and is therefore proportionate in the different metals to the intensity of the force of attraction as indicated by their absolute melting temperatures, equal absolute volumes of the metals being equal quantities.

That the gravity weights and atomic weights have no direct relationship to the specific heats, can be clearly shown thus: Assuming one cubic foot of hydrogen gas and one cubic foot of oxygen gas, each at 20 lb. absolute pressure, and 600° absolute temperature, the specific heat of the two volumes will be practically the same, and when expanded through, say, 5° of temperature they will each develop the same amount of work, although their gravity weights and their atomic weights are in each case in the proportion of about 1 to 16.

When we deal with atomic relationship we deal with the action of one atom on another, and the atomic mass, or true atomic weight, is the force with which two atoms attract each other, this force decreasing with each degree of rise in temperature from zero, passing through the solid, liquid, and vapor to the true gaseous state, where the force of attraction ceases, and the change is, in a general way, proportionate in the different metals when dealt with by equal specific volumes.

In dealing with compounds, these rules do not always hold good, as the actions of dissimilar elements on each other under the influence of heat are varied and complex, as are all the actions and reactions of chemistry, and temperature is only one of the phenomena. The accompanying table gives specific heats by equal weights and diamagnetic resistance (specific heats by equal volumes) as compared with the tensile strengths and absolute melting temperatures of the commoner metals. The tensile strengths are misleading, as they should be estimated at a temperature of zero to conform closely with the absolute melting temperatures. The tensile strengths are also largely dependent on the structural condition of the material. The figures are necessarily all irregular, as none of the quantities are accurately known, and the comparisons are not parallel in any two cases. The different metals also, no doubt, act differently under an increase of temperature, as the table would seem to show; still the relationship is too pronounced to admit of doubt that, for comparison, specific heat should be dealt with by equal specific volumes of the metals and not by equal weights. Unfortunately we know very little as to what constitutes absolute volume, and this also adds to the irregularity of the figures.

DOMESTIC PYRITE ore is now selling for 28 to 30c. per unit of contained sulphur. These quotations apply to concentrates at eastern mills. This is shipped to plants as far in the interior as Middle-West points where sulphuric acid is made.



FIG. 4. ROASTER BUILDING DURING CONSTRUCTION Photo by R. E. Price

The Humboldt Roasting-Plant

By A. A. WATSON

The Consolidated Arizona Smelting Co., at Humboldt, Arizona, is erecting four Wedge mechanical roasting-furnaces, each 22½ ft. diam., having seven hearths for roasting and one for drying, equipped with individual Cottrell dust-precipitators designed by the Western Precipitation Co. The charge to be treated will consist partly of flotation concentrate, a product of the company's Humboldt mill, partly of custom concentrate, and the remainder ¼ to ½ in. crude ore from the Consolidated Arizona Smelting Co.'s Blue Bell mine.

The capacity of the plant, when the present equipment is completed, will be 600 tons of wet charge per 24 hours, or 150 tons per furnace per 24 hours, producing a calcine containing 8% sulphur. In the design provision has been made for doubling the size of the plant as soon as other units of the smelter are enlarged.

As the flow-sheet shows, the concentrate is taken from the Portland filters up an inclined belt-conveyor to a horizontal belt-conveyor running over two 600-ton storage-bins. Another inclined conveyor brings ore from the crushing-plant to a horizontal conveyor, running over two 600-ton bins adjacent to the concentrate-bins. In planning this arrangement the need for additional bins has been kept in mind, in order that any number of them may be built in the future without radical changes to the present equipment. The ore and concentrate are distributed into the different bins by means of traveling trippers on the horizontal conveyors running over the top of the bins. The ore and concentrates are taken from the bins by Stephens-Adamson apron-conveyors, which feed a horizontal belt-conveyor operating beneath the bins. This horizontal conveyor, after leaving the storage-bins, passes underneath the custom-concentrate bins, which bins are filled directly from the railroad cars. After passing the last bins, the conveyor is provided with a Merrick weightometer, which weighs the mixed charge of ore and concentrate before it is delivered to the roaster-plant.

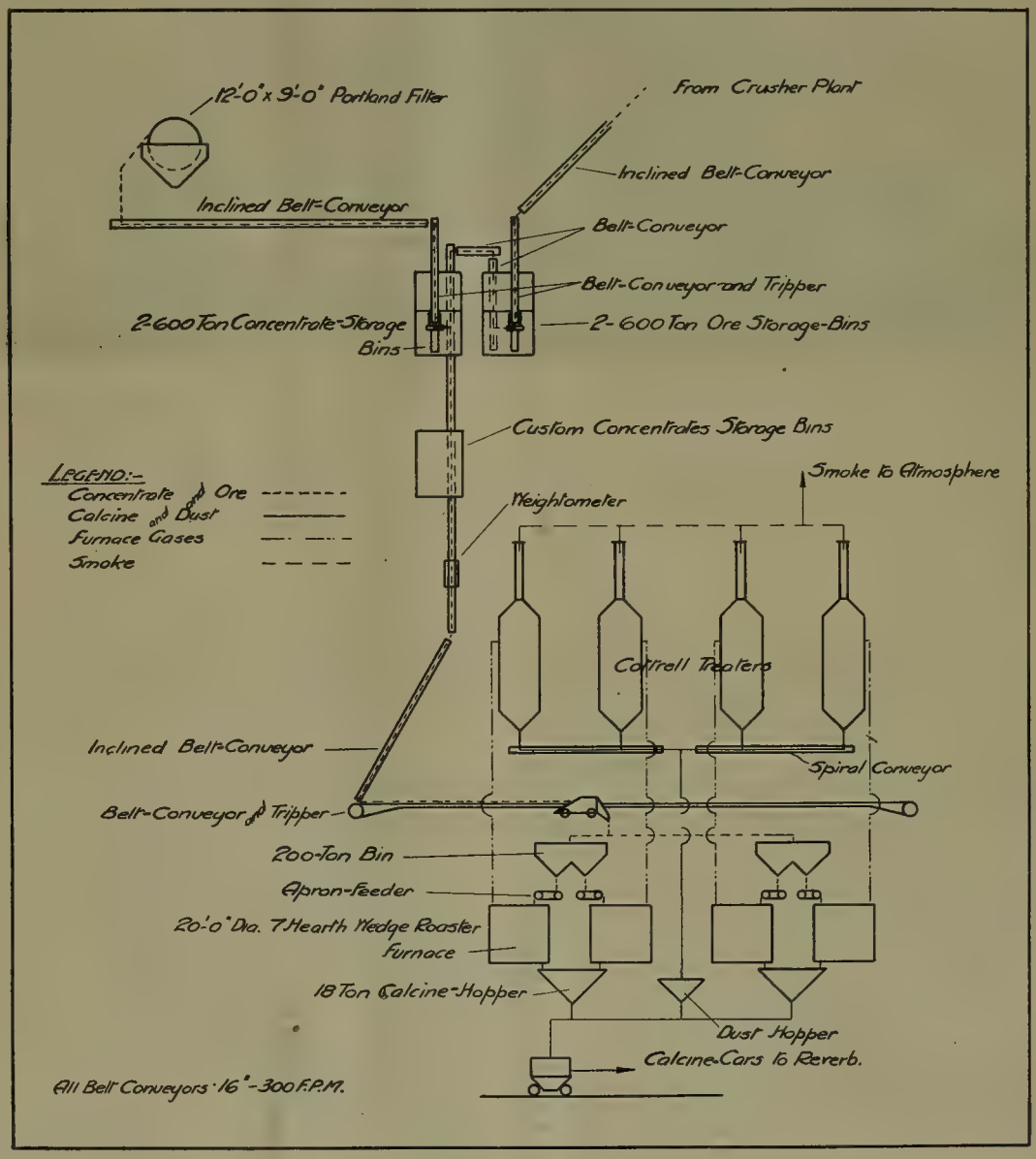
An inclined conveyor takes the charge to the top of the building, where a horizontal conveyor and tripper

distributes it into a 100-ton bin opposite each furnace. The charge is then fed by means of a Webster Manufacturing Co.'s apron-conveyor, which is driven from the furnace drive. The calcined product leaving each furnace drops into an 18-ton firebrick-lined hopper. From these hoppers the calcine is fed by gravity into standard-gauge cars and hauled to the reverberatory furnaces.

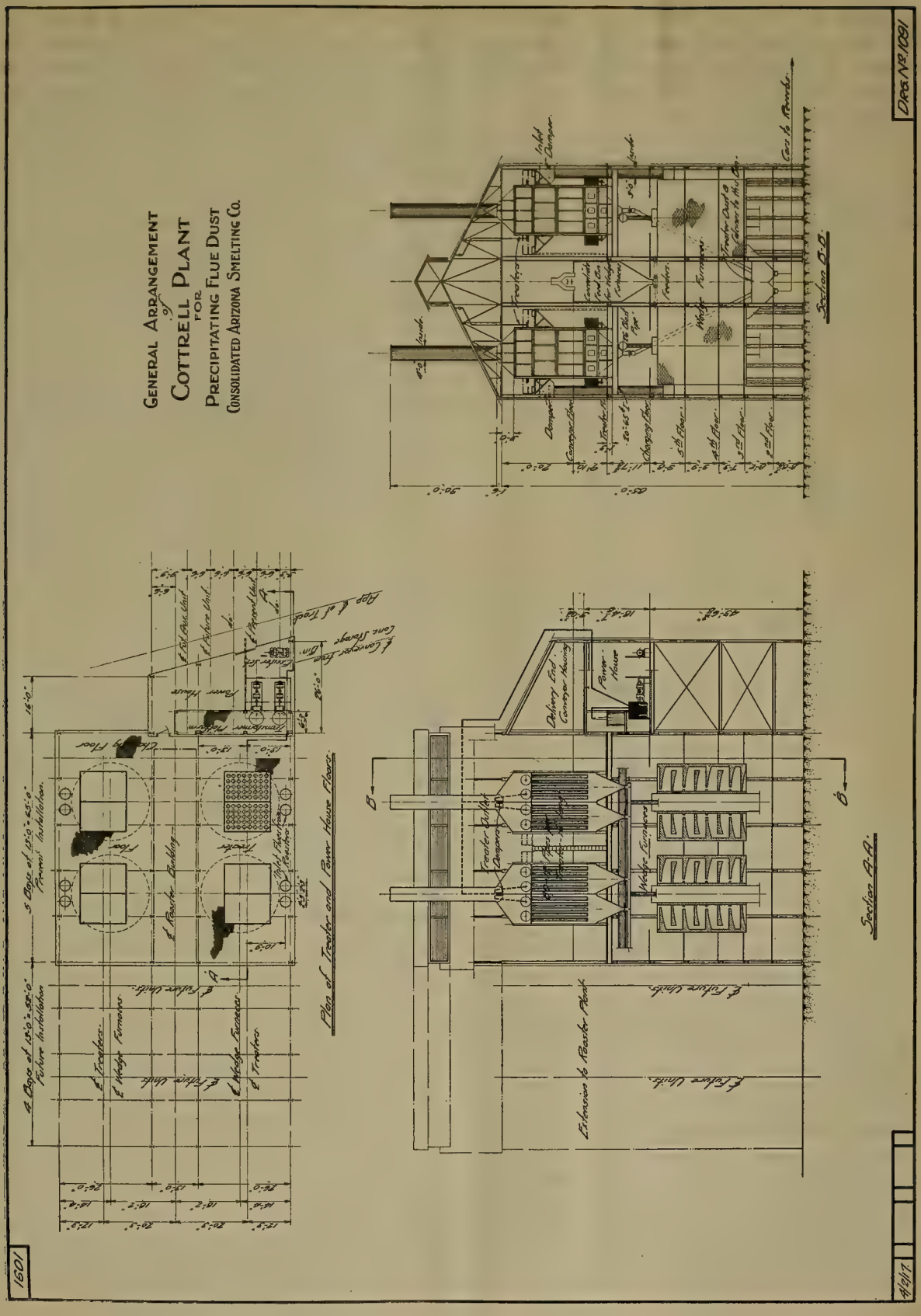
The gases from the roasting-furnaces are carried upward through two 3-ft. flues to the duplex Cottrell treaters, where the dust is precipitated and collected in hoppers beneath, the clear gases escaping through a 4-ft. stack 30 ft. high. The flue-dust collected in the Cottrell hoppers is conveyed by means of a Webster 10-in. helicoid conveyor to the end of the building, where it drops through a chute into a hopper similar to the calcine-hoppers.

The electric energy used for dust-precipitation will be derived through two Westinghouse 15-kva., 60-cycle, 250 to 100,000-volt transformers, the high-tension side of which is connected through two Western Precipitation Co.'s standard mechanical rectifiers; the rectifiers being rotated in synchronism with two Westinghouse 15-kva., 60-cycle, 250-volt motor-generators, which supply the primary current for the step-up transformers.

The Cottrell precipitators consist of two-compartment sheet-steel chambers, containing forty 12 in. diam. by 16 ft. long steel tubes or receiving electrodes per compartment. The double compartment permits repairs to be made on half of the precipitator without stopping



FLOW-SHEET OF ROASTER PLANT


General Arrangement
of
Cottrell Plant
for
Precipitating Flue Dust
Consolidated Arizona Smelting Co.
Dwg. No. 1081
Section C-C.
Section A-A.
Plan of Tractor and Power House Floors.
1601
4/17

the roaster. In each of the above tubes is suspended a No. 3 Triumph chain, which serves as the discharge-electrode. One terminal of the rectifier is connected to the chain, which is insulated, and the other to the tube, the same being grounded.

The precipitation of dust takes place as follows: The solid particles carried by the gases passing upward through the tubes are electrified with a charge of like sign as the chain, and are drawn to the tube. In a like manner a small portion of the particles are charged to

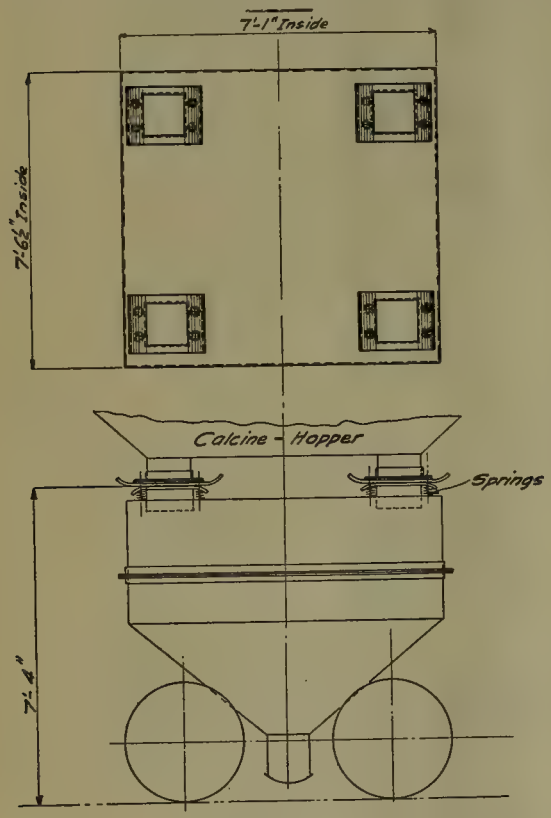


FIG. 3. CALCINE-CAR

opposite polarity and drawn to the chain. A rapping device is provided to jar the particles loose from the tubes and chains. The freed particles drop in a mass to the hoppers beneath the tubes.

Fig. 1 shows the general arrangement of the smelter. Fig. 2 illustrates the Cottrell plant. Fig. 3 is a drawing of the calcine-car in use.

The El Paso Bridge & Iron Works furnished and is erecting the steel building and treaters, amounting to approximately 550 tons of structural steel and plate. All belt-conveyors used in connection with this plant are 16 in. wide and the speed is 300 ft. per minute. They were furnished by the Jeffrey Manufacturing Co. The lengths range from 25 to 600 ft. between centres of head and tail pulleys. All gears, bearings, etc., for the conveyors and apron-feeders are of the same size and interchangeable, thus reducing the stock of repair-parts to a minimum. The roaster-building proper is of steel construction, measuring 65 ft. square and 85 ft. high to the bottom chord of the trusses. A 6-ton Otis freight-elevator runs to the top floor. The building is to be covered entirely with corrugated steel, to prevent loss in dust. The arrangement of the conveying and transmission machinery has been made as simple as possible, allowing ample working space around all the moving parts.

The arrangement for handling material is such that operating costs will be as low as possible to obtain for a plant of this size. Two of the roasters went into operation in December. Fig. 4 shows a photograph of the roaster-building under construction on November 14, 1917.

DELICATE qualitative tests for certain metals are described by E. M. Chamot and H. I. Cole ('Jour. Ind. & Eng. Chem.'). Cleanse wool fibre with alcohol and ether; then soak over night in a 1% solution of NaOH; wash, and dip 6 times alternately in solutions of 10% zinc acetate and 10% sodium sulphide, pressing out the excess but not washing; dry by pressing between filter paper. Zinc sulphide wool-fibre thus made is sensitive to 0.001 mg. of copper. The NaS should be freshly made by passing H_2S through a solution of NaOH until it will yield no precipitate with $MgCl_2$. Place a drop of the solution to be tested on an object slide, add a drop of HCl, introduce into the drop a zinc-sulphide wool-fibre about 5 mm. long, and examine under the microscope; a straw-yellow color indicates tin, lemon-yellow arsenic or cadmium, orange antimony, reddish brown bismuth, brown or yellow-brown platinum, copper, mercuric mercury, or antimony, and sometimes cobalt, iron, manganese or nickel. The color observed varies with the amount of the metal present. A check against standard solutions of the indicated metals would seem likely to aid in the color discriminations.

IODINE recovery at the Chilean nitrate plants is thus described by A. H. Rogers and Hugh R. van Wagenen in the Transactions of the American Institute of Mining Engineers. All caliche, apparently without exception, contains iodine. It is believed to exist as calcium iodate, lautarite. In leaching, this is converted to sodium iodate, which is very soluble, and accumulates in the mother-liquor in the leaching-circuit. When the concentration of the iodate in the liquor reaches 10 to 20%, the liquor is delivered into the tanks in the iodine house and treated with a strong solution of acid sodium sulphite. The sodium sulphite is manufactured by first deflagrating sodium nitrate with coal and then circulating a strong solution of the resulting crude sodium carbonate, sal natron, through towers, into which the fumes of burning sulphur are led. The sulphite reduces the iodate, precipitating iodine, which is allowed to settle and, after decanting, the clear liquid is filtered off and the iodine is caked in a cheese-press; this is sublimed in a coal-fired still, and condensed in a string of sewer tile.

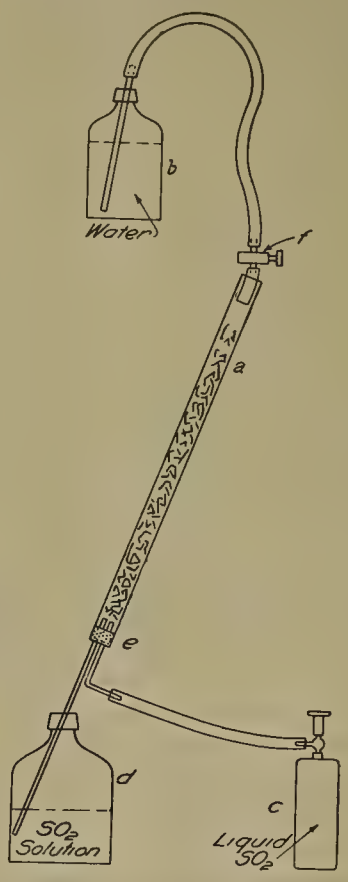
Determination of Non-Sulphide Copper

By CHARLES E. van BARNEVELD and EDMUND S. LEAVER

*Experiments with the sulphur di-oxide method were made with the following requirements in mind: (1) the method must be applicable to a wide range of ores and must be thoroughly reliable and rapid; (2) copper sulphides, especially the more easily decomposed chalcocite, must not be affected by the reagent used; and (3) metallic iron must not affect the determination. The results showed conclusively that cuprite, melaconite, malachite, azurite, chrysocolla, and metallic copper, when finely pulverized, are readily and completely soluble in sulphur di-oxide solution (sulphurous acid). Copper sulphides are not attacked, no matter how finely pulverized, nor how long the time of contact. The two essential features of the method are: (1) fine pulverization in order to completely free the particles of copper minerals from the gangue; (2) the powdered mineral must be kept in suspension by shaking or rolling during the period of lixiviation.

The procedure in the sulphur di-oxide method is as follows: Place 2 grammes of pulp, ground to a fineness of 100 to 150 mesh, in a bottle, add 100 cc. of a 3% solution of sulphur di-oxide. Seal the bottle and agitate by rolling from thirty minutes to two hours. Filter, wash the residue with sulphur di-oxide solution; add the washings to the filtrate, which will contain in solution all the copper oxides, carbonates, and silicates, and all the metallic copper. Add 5 to 10 cc. of nitric acid; boil down to 20 cc.; dilute with distilled water to 150 cc., and determine the copper by the electrolytic method in the usual way. The residue from filtration contains the unaltered and undissolved copper sulphides. In the experimental work the copper present as sulphide was separately determined in order to check the determination of the oxidized copper. Ordinarily this step would not be necessary. In analyses of the low-grade porphyry copper ores of the South-West, the sulphides may be readily decomposed and all the copper dissolved by proceeding as follows: To the residue add 5 cc. of sulphuric acid and 10 cc. of nitric acid, and boil until dense white fume appears; add 5 cc. of nitric acid, and dilute with distilled water to 150 cc.; then determine the copper by the electrolytic method. This method of determining copper in the residue is not suited for heavy sulphide ores containing interfering bases, and for such ores standard methods should be used.

Although sulphur di-oxide solution may be readily purchased, it is decidedly unstable; hence the solution should be prepared in the laboratory as needed. Small quantities are easily made by adding moderately strong sulphuric acid to scrap copper tinned on one side; the resulting sulphur di-oxide gas is absorbed in water. For continuous work it is better to purchase liquid sulphur di-oxide in steel cylinders and drums, which are obtainable in sizes holding from 6 to 200 lb. In the first experiments at the Tucson station the sulphur di-oxide gas was introduced directly into the bottle containing the water and pulp. Much loss of gas resulted and the procedure was otherwise unsatisfactory. Later the simple apparatus shown in the illustration was evolved. The absorption tower *a*, 43 in. long, made of ¾ to 1-in. glass tubing, and filled with broken hard-burned fireclay, is set at an angle of 75° between two glass bottles, *b* and *d*, of 3 to 5 gal. capacity, the bottle *b* being placed about five feet above the other bottle. The tower is open at the top, and is sealed at the bottom with a plug of sealing-wax, *e*, through which the small glass tubes extend. The



APPARATUS FOR PREPARING SO_2 SOLUTION

*Abstract: Technical Paper 198, U. S. Bureau of Mines.

upper bottle, *b*, contains distilled water, which is siphoned into the upper end of the absorption tower, the flow being regulated by a stop-cock, *f*. A cylinder, *c*, (holding 6 to 50 lb.), containing liquid sulphur di-oxide is connected to one of the glass tubes extending into the absorption tower. On opening the valve of this cylinder the liquid sulphur di-oxide issuing from the valve is gasified by the reduction in pressure, and passes into the tower, where it is absorbed by the water from bottle *b*, converted into SO_2 solution of the desired strength, and caught in the stock-bottle *d*. This apparatus gives satisfaction. With but little attention a 3% solution of sulphur di-oxide may be produced at the rate of three litres per hour. The cylinder containing liquid sulphur di-oxide, indicated in the illustration, may be replaced with a gas generator.

Considerable variation as regards strength of solution and time of contact will be necessary in treating ores from different localities. In general, a solution containing 3% SO_2 should be used. With some ores solutions as low as 0.75% SO_2 will do the work. Merely introducing the pulp into the solution, shaking the bottle for a few minutes, and letting it stand, will not dissolve the copper; constant agitation is essential. For a small number of tests a bottle-agitating machine will give satisfactory results. For analytical work, where large numbers of samples are run, as in a mine laboratory, a bottle-rolling machine will be found best. The time of contact necessary to completely dissolve the oxidized copper minerals was found to vary from one-half to two hours.

To determine the strength of the sulphur di-oxide solution an adaptation of a well-known reaction is recommended, which is based on the fact that introducing either weak or concentrated sulphurous acid into a solution of iodine will result in the complete oxidation of the sulphur di-oxide. Prepare an iodine solution by dissolving 16.8 gm. of potassium iodide in distilled water, adding 8.4 gm. of pure re-sublimed iodine, and shaking until the iodine is completely dissolved. The more concentrated the potassium-iodide solution, the more readily will the iodine dissolve. Bring the solution to the proper strength by adding enough distilled water to make 1 litre. Then standardize the solution by the thio-sulphate method, using starch indicator. The determination is made as follows: To a measured quantity of standard iodine solution add slowly, with constant stirring, the proper volume of sulphur di-oxide solution. So regulate the volume of the iodine solution used that the mixture always contains a decided excess of iodine over the quantity required to oxidize the sulphur di-oxide being added. An excess of sulphur di-oxide causes the solution to clear and to lose its dark red color. If an excess of sulphur di-oxide is added the determination is spoiled, and the test should be repeated with fresh SO_2 solution and a larger quantity of iodine solution. Thus, there is a direct ratio between the strength and quantity of sulphur di-oxide solution and the quantity of standard iodine solution. For solutions containing one to three per cent sulphur di-oxide 1 cc., and for weaker solutions 20 cc., of standard iodine solution should be used. The mixture is then titrated by the thio-sulphate method to determine the quantity of iodine remaining in the mixture. The difference between this quantity and the total quantity of iodine represents the iodine used in oxidizing the sulphur di-oxide. The strength of the sulphur di-oxide solution may then be calculated according to the formula:

$$SO_2 + H_2O + 2I = 2HI + SO_3$$

The method is applicable alike to high-grade and low-grade ores. The manipulation is simple and the possible sources of error are few. One chemist can keep a 6-unit electrolytic outfit working to full capacity on porphyry ores. Any metallic copper present would be reported with the oxidized copper. If a separate determination of metallic copper is considered necessary this may be made by amalgamation, preferably in an amalgamated copper pan.

Cost of Excavation for Mill

The following figures give the cost of excavation for the mill of the Holden Mining & Milling Co., at Tuscarora, Nevada, under the superintendency of J. D. Hubbard.

Character of ground, about two feet of tight top-soil (clay, earth, and broken rock), the rest being rock that had to be blasted. All material moved an average distance of 100 ft. Cost of common labor $4 per shift of eight hours. Miners at $4.50 per shift. Teams, two horses and driver, at $7 per shift. Dynamite (40%) cost 26c. per lb. Detonators, $2 per 100. Fuse, 75c. per 100 ft. Material removed:

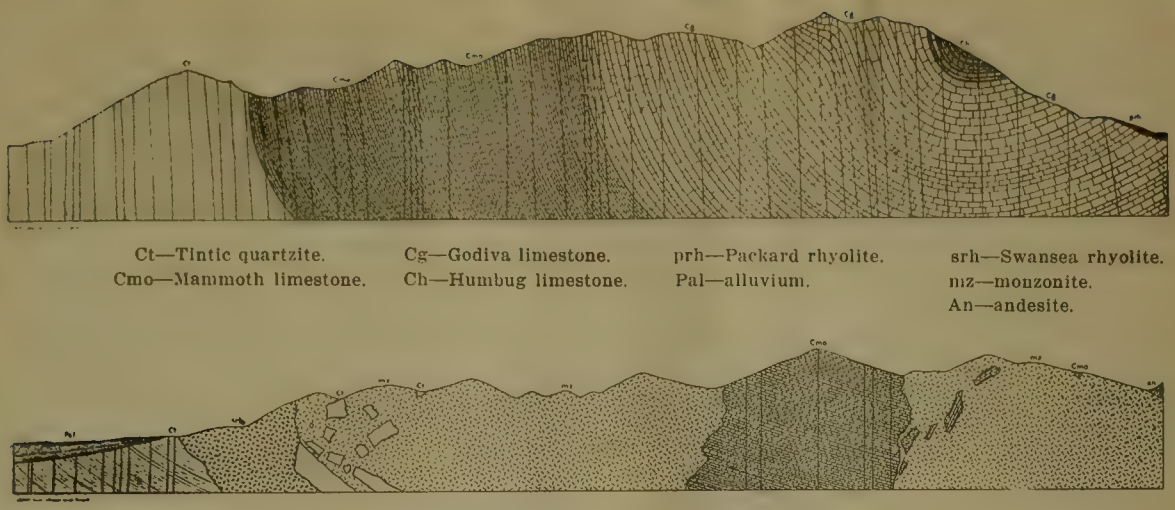
	Cu. yd.
Lower bench	650
2nd bench	707
3rd bench	634
4th bench	362
Upper bench	20
Total	2,373

Costs:

Labor, November 1917	$1,535.75	
Labor, December 1917	2,924.50	
Labor, January 1918	317.00	
		$4,777.25
Explosives		110.75
Wear on tools		36.00
Blacksmithing and general expense		145.00
Superintendence		298.00
Total		$5,367.00

Cost per cu. yd. = $2.26127.

As a comparison it may be noted that the average prices on this class of work on contract basis for the large railroad companies was from $2.50 to $3.50 per cu. yd., and when price of labor was $2.25 per day, powder 12c. per lb., and a 10-hour day obtained.



CROSS-SECTIONS OF THE TINTIC DISTRICT

The East Tintic District, Utah

By BENJ. F. TIBBY

Tintic lies about 65 miles south of Salt Lake City and on the west slope of the Tintic mountains. This district, of which Eureka is the principal town, is one of the oldest in Utah. Recent important developments have brought into prominence the eastern part of the district.

The rocks of the area consist of a series of Paleozoic sediments and a variety of Tertiary igneous masses. The structure of the Tintic mountains, within the limits of the important mines, is that of a simple syncline with an axial trend in a general north-south direction. The axis of the fold pitches, and to the south the axial plane has a westerly dip. The sedimentary rocks are limestone and quartzite, with minor intercalations of slate and shale. The limestone has been differentiated into three principal formations, and designated from younger to older as the Humbug, Godiva, and Eureka members. Under these is the quartzite. Igneous rocks are present as sheets of rhyolite and andesite, together with an intrusive monzonite, the last having a close genetic connection with the orebodies. The sedimentary beds on the west limb of the syncline have a steep angle of dip, sometimes overturning, while the beds on the east limb have a more gentle dip, rarely exceeding 40°. The trough of the syncline forms the highest topographic features and may be taken as a rough line of division between two distinct portions of the Tintic district, namely, the eastern and the western.

Ore is found in the sedimentary rocks, in the igneous rocks, and at the contact of the two, but the economic importance of the first far overshadows the others. The workings of the large and more important mines are in the limestone beds of the western limb of the syncline, or in close proximity to its axis on the eastern limb. The less steeply inclined beds of the eastern limb are almost completely covered by a cap of rhyolite, the limestone showing in only a few places, either as isolated islands in the sea of rhyolite or where erosion has cut through the igneous sheet and exposed the limestone at lower elevations.

The principal bodies of lead-silver ore that have made the district famous as a dividend payer are those that occur as metasomatic replacements in the limestone. The deposits in the igneous rocks, or at the contact of the igneous and sedimentary rocks, are of secondary importance. In the sedimentary rocks an extensive series of north-south fractures, parallel with the axis of the syncline, and of vertical or nearly vertical dip, are closely associated with the genesis of the ore. Because of the greater amount of development work most of these fractures have been found on the western limb of the syncline, but they also constitute an important geological feature of the eastern limb.

The genetic importance of these fractured zones has been a subject of disputation. Guy W. Crane has said:* "In an earlier report on the Tintic district, reference is frequently made to the north-south fissures, which, it is contended, have governed the course of the ore-channels. The writer's investigations have not confirmed the common presence of such north-south fissures within the ore-zone, but, on the contrary, have gone to show that practically all the major faulting of fissures in the district is of the nearly east-west or transverse type," George W. Tower and George Otis Smith† hold that the north-south

*Trans. A. I. M. E., Vol. LIV, p. 351.

fractured zones have played an important and principal part in the ore deposition. The recent developments at the Tintic Standard* show plainly this marked general north-south fracturing associated with the ore, while up to this time, at least, no transverse fissuring of importance has been noted. The ground-water level in the sedimentary rocks stands near the 1200-ft. level of the Bullion-Beck mine. The 1300-ft. level of the Tintic Standard mine is still above ground-water level. Considering the district as a whole, completely oxidized ores extend downward for several hundred feet from the surface and partly oxidized minerals form the principal ores of the deepest workings. Leaching processes in nearly every case have removed effectively all but a mere vestige of the metallic minerals from the surface, and such outcrops as are visible present a barren and uninviting appearance. Geological deductions have been the means of uncovering many bonanzas. The original discovery and point of sinking the operating shaft for one of the principal mines was on a fissure in the limestone that offered no trace of valuable mineral at the surface and the first ore encountered was below the 200-ft. level. Quoting from the above-mentioned report of the U. S. Geological Survey: "In the Bullion-Beck, the ore does not extend above the 80-ft. level. In the Gemini it is not found above the 200-ft. level and not in paying quantities above the 400-ft. level." Speaking of the extensive orebodies of the Eureka Hill and Bullion-Beck mines the report says: "The only known croppings of these orebodies occur on the hill slopes just south of the Eureka Hill shaft. The Silver Gem orebody does not appear at the surface." Referring to the Gemini mine: "The ore occurs in fractures parallel to and crossing the bedding of the limestone. They have a vertical range of 100 to 400 ft., rarely exceeding 600 ft. in length. They do not appear at the surface." These statements have reference to the ore occurring in the limestone, but it is a matter of fact that the outcrops in the igneous rocks also are for the most part barren. The contact of the limestone with the igneous rocks is conspicuous by the presence of iron oxides carrying little or nothing of the more valuable metals. A large amount of this iron-bearing material has been shipped to the smelter as flux.

The orebodies in the limestone were formed prior to the effusive overflow. While, as noted, the extent of the fracturing on the eastern limb of the syncline is not so great as on the western limb, there is no reason for believing it does not exist in the limestone beneath the igneous capping. Whether these fractures will prove as prolific a channel for mineralizing solutions as elsewhere remains to be demonstrated.

The area of East Tintic is traversed by a series of north-south outcrops that stand above the rhyolite country-rock, and are, therefore, later than the fractures that produced the orebodies in the sedimentary rocks. These outcrops differ from the rhyolite in composition and by virtue of their hardness are easily observable above the surface mantle. If valuable minerals were ever present in these outcrops they have been removed by leaching. No development of any consequence has been done on the outcrops to prove their value in depth.

It is a sound geological deduction that the eastern fold of the syncline should prove a place for ore, but in most cases prospecting in the underlying sedimentary rocks was precluded by the cost of penetrating the overlying rhyolite cap. Several years ago a portion of this area was tested by churn-drilling; later an attempt was made to apply this method of work to the patenting of lode-claims, it being held that it was a most satisfactory method of development. The Land Office decided otherwise, but later, after a contest extending over two or three years, the contention of the mine-owners was allowed and drill-holes were ruled to come within the scope of development work necessary to secure a patent on lode-mining claims. Until the last two or three years mining in the East Tintic district was small in scope, and while a little ore had been uncovered in several places, it remained for the Tintic Standard Mining Co., under the persistent efforts and able direction of E. J. Raddatz, to open an orebody of substantial proportions, and thereby prove definitely what had heretofore been only an attractive geological deduction. The geological conditions in the Tintic Standard are similar to those in the western part of the district, the orebodies being associated with the north-south fractures. Development of the Tintic Standard orebody was effected through a shaft together with a series of drifts and winzes. This did not afford an economical method of bringing the ore to the surface, so a new shaft was begun and has been completed to a depth of 1300 ft., a connection having been made at this level with the old workings. A peculiar fact in connection with the sinking of this new shaft was that within 250 ft. of the collar the westerly dipping limestone outcrops, and yet the shaft penetrated 550 ft. of the rhyolite before entering the limestone. The last 750 ft. of sinking was entirely in the limestone. In the upper portion of the limestone the beds had their characteristic westerly dip. In the lower part of the shaft the broken and shattered condition of the limestone concealed any traces of the bedding. The lowest station of the new shaft is at 1260 ft. From this level a drift was driven 200 ft. eastward, penetrating a new orebody. The ore that is being shipped at the present time is principally sulphide, an unusual condition compared with other mines in the district. There is, however, an abundance of oxidized ore. An electric hoist and an electrically driven compressor have been installed. For the week ended February 9, thirteen cars of ore was shipped from the Tintic Standard. The stope from which this ore was taken is already seven sets wide, two sets high, and 130 ft. long, with all sides of the stope still in ore. Samples show an average of 70 oz. silver, $5 gold, 12% lead, and 3% copper. Without question this discovery is the most important that has been made in the Tintic district for many years.

†19th Annual Report U. S. Geol. Sur., Part III, 'Geology and Mining Industry of the Tintic District, Utah.'

*See map on page 345.



NEW YORK

A. I. M. E. Meeting.—Exchange With Chile.—Potash Production.

Technical papers at the A. I. M. E. meeting last Tuesday were of a generally high standard, and sessions were well attended. In one instance much time was taken up in demonstrating a newly-patented apparatus of limited application, although of some interest. Impression was created in some quarters that the facilities of the Institute had been taken advantage of for the purpose of advertisement, and the question might be asked as to how a line could be drawn if all patentee members were to take a similar course. A number of pertinent questions were put as to the applicability and operation of the method, and this served to indicate that the patentee had avoided much expense and trouble by using the Institute and its bulletins as a medium for publicity rather than the usual trade channels. In another instance one of the papers submitted dealt with the results of small and large-scale tests carried out for the apparent purpose of disproving the correctness of the theories supposed to underlie the operation of a patented machine. The author apparently proved his point by a drastic reversal of normal operation; but in this instance the patentee was absent, and no discussion bearing on the important points raised in the paper was submitted. An interesting series of views of Bolivian tin mines was given later in the afternoon by Mark R. Lamb, and the usual smoker was held in the evening. This was a successful reunion. Representatives of the British Army and the French Commission gave brief addresses, and were received with acclamation. The policies and attainments of the more important Government bureaus at Washington were ably championed by their representatives. At a meeting of the Woman's Auxiliary held on Wednesday morning, Dr. Vernon Kellogg of the U. S. Food Administration, drew attention to the compulsory rationing in England at the present time, and voluntary rationing here, and stated that Mr. Hoover's 'honor' ration of 2½ lb. of meat per week was 1½ lb. in excess of the English ration per capita, and that whereas ¾ lb. of sugar was allowed here only 2 oz. per week per capita was allowed in England. Compulsory rationing must inevitably follow here if the honor ration is not voluntarily complied with, the speaker asserted. A distinguishing feature of Wednesday's sessions was the attention directed to and interest displayed in papers dealing with employment and sociological problems, for which T. T. Read may be accorded much credit. A paper was presented during the morning by Dr. T. Darlington, formerly Health Commissioner for New York City, dealing with illness among industrial workers and losses incurred thereby by their employers. A number of additional points of interest were brought out in the subsequent discussion. In the afternoon a new precedent was set when Mrs. Gilbreth formally presented a paper written by her husband (Major Frank M. Gilbreth, the well-known author of 'Motion Study'), and charmed those present by a short address during which she dealt with the problem of the crippled soldier and the valuable service that he might be allowed to give if suitable work were found him. Mrs. Gilbreth concluded by an appeal to engineers and managers to consider the question, and to do all they could to anticipate having to provide employment for such men wherever opportunity occurred. Her address was illustrated by latern-slides showing how a number of phases of human effort in industry could be capably controlled by limbless men. Other important aspects of the employment problem were discussed, including the wastage due to unnecessary labor turnover—estimated to cost the country between two and five billion dollars annually—education of employees, and housing. The intrinsic value of an education among all employees was demonstrated by a representative of the National Association of Corporation Schools, an institution that co-operates with pre-existing schools of all kinds and aims to promote the specialized training and to insure the co-ordination necessary for industrial and commercial efficiency. The Association now contains a membership of 118 prominent firms in the leading industries of the country, representing a capitalization of over $3,000,000,000. The importance of the housing problem was dealt with by a representative of the National Housing Association, who described the benefits to the companies, which had expended an amount equivalent to one-third of one per cent of their payroll to provide adequate and satisfactory accomodation for employees. The cost of replacing men in factories was estimated at from $40 to $50 per head, and this fact was emphasized as an incentive to the provision of adequate housing facilities. Government action was illustrated by the fact that $50,000,000 was recently set aside for building workmen's dwellings to house shipyard employees. Another bill for a like amount was to be introduced shortly, the money to be loaned to private firms unable to finance the necessary extensions. The usual dinner was held at the Hotel Biltmore in the evening, and was well attended. Bainbridge Colby, Director of the U. S. Shipping Board, was the speaker of the evening; in his introductory remarks he deprecated the retiring Institute president's somewhat critical attitude. On Thursday there was an all-day excursion to Princeton, where members of the Institute were guests of the University. Luncheon was served in Proctor Hall of the Graduates College, and was followed by an interesting address by President Hibben, who, after dealing with the importance of engineering and technics in the progress of the War, criticized the philosophy that pretended that what was right today was false tomorrow. Right must remain right, and not be susceptible to modification by military necessity or by the exigencies of the situation. He insisted that we should eliminate further reference to the destiny of the country as the ultimate victor and consider the unpleasant but obvious truth that, for the present at least, Germany is winning the War. To achieve her final triumph the United States must put forth her full strength in those vital and influencing factors of technical education, technical training, technical initiative, and inventiveness. Philip N. Moore replied on behalf of the Institute. The afternoon was spent in visits to University buildings and laboratories.

Weakening of British financial influence in South America is seen in the official recognition by the Chilean government of dollar exchange. This action is one that has caused much comment and favorable criticism. Export duties on nitrate shipped from Chile may be liquidated by drafts on New York in United States dollars, and it is hoped that the concession may be extended so that import duties into Chile may be met

by the same currency. Previously only sterling bills drawn on London were accepted, which involved circuitous transactions and cumulative commission costs.

Optimistic forecasts with reference to America's independence of German supplies of potash formed the basis of a recent address by a vice-president of the Du Pont Nitrate company, who intimated that his company had achieved production at the rate of 10,000 tons per annum of a product containing 25% of potassium nitrate, equivalent to 1200 tons of K_2O. It was stated that there were 200 oficinas or nitrate plants in Chile capable of producing a like amount, by which a total of 240,000 tons per annum might be arrived at—a figure capable of enlargement, it was stated, by more exact methods of beneficiation, to 720,000 tons. This latter amount was apparently the nearest that could be obtained by any stretch of the imagination to approximate Germany's sale before the War, amounting to 900,000 tons. As an addendum to this somewhat remarkable prognostication it may be pointed out that the estimated number of operating plants in Chile is over-estimated by about 100%, and that much of the caliche contains practically no potash.

An air-mail service will be established between New York, Washington, and Philadelphia within the next few months, it is reported. Three hundred pounds of first-class mail will be carried by each machine. The service will commence with one round trip per day, and tenders have been invited by the Post-Office for the machines required.

CRIPPLE CREEK, COLORADO

DRAINAGE-TUNNEL.—ORE-DUMPS.—ISABELLA.

Two shifts are working in all headings of the Roosevelt drainage-tunnel. The main opening is being extended toward the Golden Cycle shaft of the Vindicator company on Bull hill, and drifts are being driven to Portland No. 2 shaft on Battle mountain, and the Cresson main shaft on Raven hill.

The tunnel was advanced 112 ft. in the main heading during February, while the Portland cross-cut was driven 93 ft. and Cresson drift from the tunnel-level, 112 ft. Flow of water through the measuring-weir at the tunnel portal now measures 3575 gal. per minute.

With reference to sale of mine-dumps by Stratton's Cripple Creek Mining & Development Co., mentioned in the issue of March 2, other applications have been filed, but will not be acted upon until returns are received from initial shipments sent out under existing contracts. Under sale conditions, 75c. per ton is to be paid the Stratton estate for the ore and a deposit of $75 is required prior to shipment of each 100 tons. The dumps must be moved entirely. No less than 2700 tons was moved during January from the Economic dump, on the western slope of Squaw mountain, and shipped to the Golden Cycle plant at Colorado Springs. Average gold value was $3.10 per ton.

W. P. H. Leasing Co. has made a rich strike in the W. P. H. mine of the United Gold Mines Co., on Ironclad hill. At the bottom or 900-ft. level, a fault-vein, recently exposed, is from 4 to 8 ft. wide, and outside of a white talc streak, is averaging 2 oz. per ton. Initial shipment gave $38.10 per ton. The talc streak, 2 to 4 in. wide, is filled with calaverite crystals, and is worth many dollars per pound.

Annual report of Isabella Mines Co. shows that the Bull Hill properties of the company were operated at a loss during 1917. Total receipts amounted to $143,357, and disbursements $163,660, a deficit of $20,303. Company has a cash balance of $38,798, with supplies valued at $3350. At present, in addition to company work, there are 15 sets of lessees. More ore is now being mined by lessees than for some time.

Dividends for March declared by Cripple Creek companies are as follows: Gresson Consolidated, 10c. per share, total, $122,000; Golden Cycle M. & R. Co., 3c., $45,000; and Granite Gold Mining Co., 2c., $16,500. All are payable on March 10, and total $183,500.

LEAD, SOUTH DAKOTA

MANGANESE.—NEW AERIAL TRAM AND MILL.

DEADWOOD.—Deadwood Lead & Zinc Co. continues erecting 10-stamp concentrating plant, and expects to have it ready early this summer. Buildings are complete and installation of machinery proceeds. Ore containing gold, silver, lead, and zinc will be treated. Development of mine continues.

LEAD.—Initial shipment of 31 tons of manganese ore made by J. F. Street from the Fremont property contained 49.6% manganese, 1.82% iron, 3.17% silica, and 0.039% phosphorus. Total value was $1671. Erection of a concentrator to dress lower-grade material is being considered.

TERRY.—Mogul company has completed installation of aerial tram from mine to mill ore-bins. By new arrangement ore is drawn through chutes at the working-adit, from where it goes to a tram pocket at the portal. Main adit has advanced 600 ft. and is below the ore-zone, making use of raises and chutes advantageous. Tram his been placed in commission and eliminates railroad transportation.

LORDSBURG, NEW MEXICO

ACTIVITIES IN THE STEINS, BURRO SPRINGS, AND LORDSBURG DISTRICTS.

There is more mining activity at Steins than for some time. Several operators are extracting ore for shipment and others are doing development work. Plans are being made to erect ore-bins and more adequate shipping facilities here.

Fred. P. Davy has taken a lease on the Silver Hill mine, three miles south of Steins, from Cloudman and Bradford. Ore contains lead and silver. Shipments will be made to the Ozark Smelting & Refining Co., at Coffeeville, Kansas, the freight rate from Steins being $6.50 per ton. Cloudman and Bradford have several cars ready for shipment and Mr. Davy plans to sub-lease some of his ground where ore is developed, so that regular shipments may be made. He plans to install a compressor and machine-drills at his lease.

Trigear and Conolly continue to work the Merrimack mine.

Mr. Rice, of Douglas, Arizona, is operating the Rice property.

Mr. Thompson, of Miami, Arizona, is shipping some lead ore from the Clifford group.

The McGee company continues development.

After being practically dormant for a number of years there is again activity at Burro Springs, on the west side of the Burro mountains, 30 miles north of Lordsburg, where J. C. Brock has developed an excellent gold-silver-lead group of claims. Vane Gould, the McGeary Brothers, Ed. Baker, and Will Layne are operating the mine with Mr. Brock, and will soon have a shipment of ore which will probably be sent to El Paso. Work is being done by hand, but as soon as boiler repairs are made the owners plan to use power throughout. The mine is equipped with practically enough machinery for a treatment plant, and this is planned by Mr. Brock if water is encountered during development. There is considerable new mining machinery available. This property has not been worked for shipping for many years, but now stands good chances of coming to the front.

In the Lordsburg district, the 85 Mining Co. is to cease mining operations for about a month in order to install a new hoist and do development prior to starting its new mill.

The Atwood mine operators have changed the name of their company to the Boston-Emerald Mining Co. The only work being done at present is keeping the water down in the Atwood shaft. It is planned to have complete machinery and to begin work about March 25.

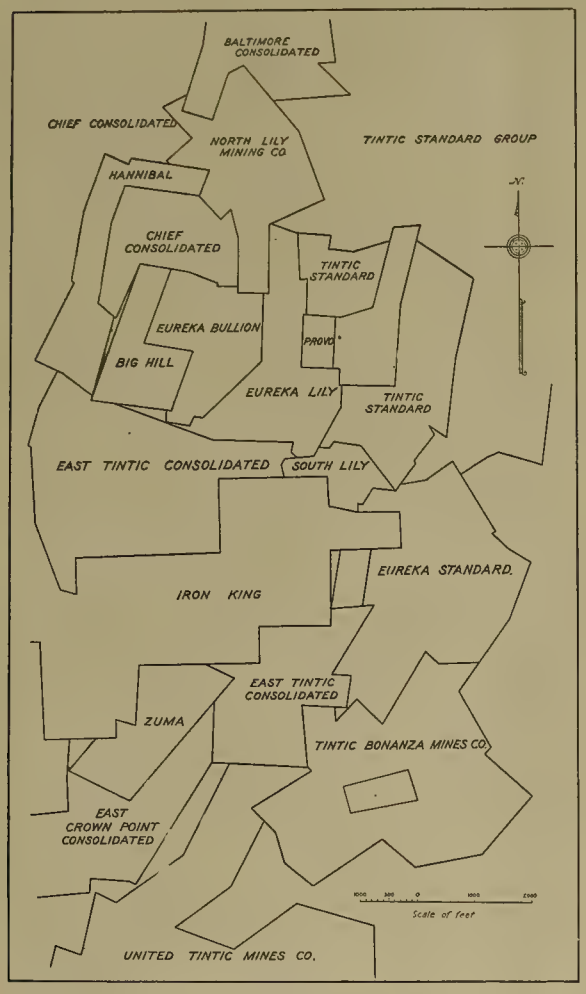
TINTIC, UTAH

LUCKY SHEPHERD, CHIEF CONSOLIDATED, AND MCCRYSTAL MINES AFFAIRS.

Lucky Shepherd mine in West Tintic district is to be reopened, under control of W. D. Rawson of the Tintic Delaware nearby.

Ore sales of Chief Consolidated Mining Company in 1917 totaled $1,554,714, less $1,127,316 expenditure, $152,409 to various properties, and $309,452 for dividends. Balance at end of 1916 was $477,295, and $262,394 at end of 1917. Dividends to date total $925,392.

The four McCrystal mines—Gemini, Godiva, Eureka, and Ridge & Valley—are operating under favorable conditions. The first has 100 lessees at work, and is developing at 1700-ft. depth. A joint pumping scheme is worked with the Ridge & Valley. Godiva has 20 men, mostly employed on 1200-ft. level.



PART OF THE TINTIC DISTRICT, UTAH

In order to quiet title to ground in the eastern end of the district, Chief Consolidated has filed suit at Provo against the Central Standard Mining Co. (formerly Canyon Siding), asking to be adjudged owner of four claims on which it is alleged the defendant company has encroached in making a survey for patent. There will probably be other suits in that area made known by the Chief Consolidated. Officials of this company state that they have no desire to make trouble for claim-owners, or to take anything for which they have not a clear title, but they cannot but realize that many of the claims now so carefully guarded were open to re-location when they commenced taking up mineral ground in that section a few years ago.

Ore shipped from Imperial lead mine, 40 miles west of Tintic, assayed 1.4 oz. silver, 40.35% lead, 6% iron, and 2.1% zinc. Six carloads were sent to the smelter.

LUCIN.—Ore assaying up to $235 per ton in silver and copper has been opened by the Lucin Copper M. & M. Co. in an adit. This property contains 8 claims.

HOUGHTON, MICHIGAN

DEEP SHAFT WORK OF CALUMET & HECLA

The Red Jacket and Tamarack No. 5 vertical shafts of Calumet & Hecla are to be used to more advantage as soon as possible. These offer possibilities for great saving in operation and further economies in hoisting ore. The Red Jacket has a capacity of 3000 tons daily; this is not half utilized at present. There are six compartments; two for ore, one for bailing water, when necessary, one for supplies, and one for men. The shaft is straight to the 81st level, or bottom, nearly a mile deep. Levels are measured on the conglomerate angle shafts. From the bottom of Red Jacket shaft there is a long crosscut, running parallel to the lode, and to the north of the shaft. From this point the company continues to mine from the rich 'five forties', and there are ore-reserves in that section, tributary to the Red Jacket shaft, that will require at least 15 years' work to extract at present rate. This north opening also permits working the rich conglomerate under No. 3 Tamarack, formerly known locally as the North Tamarack mine. Notwithstanding the great depth, and the slope shaft, this ore is handled at a cost not as high as that of the inclined shafts operated in the old way.

All of the Hecla and South Hecla shafts on the conglomerate lode of the Calumet & Hecla mine are deep. According to the last annual report No. 6 shaft was 7874 ft., 133 under the 79th level, and No. 7 was 7977 ft. or 140 ft. under the 80th level. Both are deeper at this time. At the South Hecla, sinking No. 8 was discontinued at 6120 ft., and at No. 9 and 10 the depth is 8132 ft., 142 ft. under the 82nd level. A drift has been started from No. 5 shaft, Tamarack, in the amygdaloid, 200 ft. from the foot-wall of the conglomerate, which is looked upon by miners as the preliminary step toward underground preparation to handle ore from at least four shafts through the Red Jacket shaft. Ore from the Hecla and South Hecla shafts, below their present depth on the 81st level, could easily be handled in this manner, and these shafts could then be permanently bottomed and all rich pillars and arches extracted. These shafts today present a deep mining problem that appears to offer a probable solution by the utilization of the motor-tram to either No. 5 Tamarack or Red Jacket shaft for haulage to surface. Application of this idea would release rich ore that is tied up in these long inclined shafts. Present cost of maintenance of Hecla and South Hecla shafts is very heavy. In No. 8 shaft, for instance, where sinking was suspended at the 63rd level, it is possible to take out arches and pillars from five levels per year. Practically none of this work has been done at shafts 6, 7, 9, and 10.

Tamarack No. 5 is 1200 ft. distant from the Red Jacket shaft. The reason the drift from this shaft was started in amygdaloid was for safety purposes only. At this depth a conglomerate drift would be out of the question. Electric haulage from various underground points to the vertical shafts is quite successful. Storage-battery locomotives are used entirely. In addition to the application of this idea to Hecla and South Hecla shafts there seems no reason why No. 2 shaft of the Tamarack mine should not be so equipped. At present it is generally believed that plans have not been worked out to a point where Calumet & Hecla is ready to make them public.

PLATTEVILLE, WISCONSIN

SUMMARY OF RESULTS IN ZINC REGION DURING FEBRUARY.

Zinc miners will long remember the past winter, the worst ever experienced. January snow and ice hampered operations in February, when there was a considerable car shortage, a coal famine, and bad roads. Additional to these burdens were further advances in price of powder and steel, hoisting cable was unobtainable, power companies demanded increased rates, tax collecting by town authorities, and low prices for zinc ore. Sales of ore from mines to smelters were light in February, the weather not being responsible entirely, but largely due to the market. Lead ore was steady at $85 per ton throughout the month. Shipments were only 385 tons, out of stocks estimated at 2500 to 3000 tons. Gross extraction of mine-run ore was 13,423 tons, and net deliveries to smelters were 7273 tons.

Shipments of ores from mines to smelters direct and from mines to ore-dressing plants were as follows in February:

District	Zinc, lb.	Lead, lb.	Pyrite, lb.
Benton	18,122,000	288,000	826,000
Mifflin	2,882,000	140,000	.....
Galena	2,468,000	88,000	.....
Linden	1,318,000	68,000	530,000
Hazel Green	530,000	.....	.....
Cuba City	520,000	.....	1,934,000
Highland	420,000	.....	.....
Platteville	192,000	.....	.....
Dodgeville	174,000	.....	.....
Shullsburg	110,000	126,000	.....
Total	26,736,000	710,000	3,290,000

The labor situation was much relieved because of disorganized conditions. In the Linden district alone more than 200 miners were thrown out of employment, many of whom found employment at other points. Some new producers were started in the Hazel Green and Shullsburg districts, and no trouble was experienced in recruiting working forces. Building operations in the Cuba City district and at Linden enabled mechanics to find ready employment. While weather conditions made road improvement difficult, many operators took advantage and bedded soft stretches with 'chats' from the mills, that will help when the real spring thaw, now near at hand, commences. Established railroad schedules were being better observed toward the close of February. Prominent operators think that the heavy output of late in 1917 will be regained slowly this year.

MANILA, PHILIPPINE ISLANDS

BENGUET CONSOLIDATED COMPANY'S RESULTS IN 1917.

Little mining news is available from this Territory, so that an abstract of the above company's report for the past year should be of interest. The mines are at Antamok, Benguet, and C. M. Eye is superintendent.

	December	1917
Ore treated, tons	1,939	20,427
Gold content	$32,033	$363,762
Average per ton	16.32	17.80
Loss as dissolved metal	203	3,078
Loss as undissolved metal	3,056	43,508
Tailing loss in solution, per ton of tailing discharged	0.11	0.15
Tailing loss in undissolved metal per ton tailing discharged	$1.57	$2.12
Extraction, per cent	90.00	87.10

There were sent to the Mint at San Francisco 156 bars, weighing 23,279 oz., containing 14,799 oz. gold and 4444 oz. silver. The bullion was 636 fine in gold and 190 in silver. Estimated value in bullion shipped, $309,444, and total indicated saving $317,176. The value of slag and matte on hand is sufficient to cover difference between this figure and value of bullion, with enough over to bring the production for the year to $325,000. No account is taken in monthly production record of silver content of the ore, which materially swells the market value of bullion, slag, and matte.

Four dividends of 5% and one of 2½% were paid in 1917, amounting to ₱225,000, and approximately ₱100,000 capital expenditure was made.

MEXICO

GENERAL NEWS OF THE REPUBLIC.

MEXICO CITY.—During the last six months of 1917 the Department of Industry and Commerce issued 320 mining titles, mostly for exploitation of gold, silver, and copper; though a number included lead, zinc, iron, etc. These new titles were distributed as follows: Sonora, 117; Nuevo Leon, 45; Chihuahua, 31; Durango, 26; Jalisco, 15; San Luis Potosi, 13; Zacatecas, 11; Hidalgo, 10; Michoacan, 10; Coahuila, 9; Guanajuato, 7; Sinaloa, 6; Oaxaca, 5; Puebla, 5; Nayarit, 3; Queretaro, 3; Tamaulipas, 3; Lower California, 3; Mexico, 2; Federal district 1. It will be observed that the greater portion are in the States of Sonora, Durango, and Chihuahua, which are widely declared by misinformed periodicals to be in a state of complete unrest, says 'The Oasis' of Nogales, Arizona.

The government of Michoacan has issued instructions to the municipal authorities of the State to proceed immediately with the distribution of unoccupied lands among the people wishing them, in order that no time may be lost in preparing for the coming crop. This distribution will be subject to future regulation by the Agrarian Commission and to arrangement regarding their purchase from the owners or their rental therefrom. Congress of the State of Mexico will probably adopt the same law governing the use of unoccupied lands in that State, that was recently adopted by the National Chamber of Deputies for the Federal district and the territories. This law provides for the allotment of such lands to those desiring to make use of them for agricultural purposes.

It is expected that by March 1 the exhibitions of natural and manufactured products, authorized some time ago, will be opened in all of the consulates in the United States and Canada. Similar exhibitions will also be established in various European cities.

One of the large petroleum companies has offered to supply all dependencies of the National Government with gasoline and other oil products at 20% less than the market rate when in bulk, and at 15% when in packages. The offer has been accepted.

The Cananea Consolidated Copper Co. has been notified that unless it complies with the terms of a concession granted that concern for the construction of various railway lines within the State of Sonora within a reasonable time, it will be nullified.

Some time ago a number of locomotives from the National lines were sent to the United States to be repaired, facilities of Mexican shops being overtaxed. These engines are now being returned in full working order.

The second Workingmen's Congress has been called to meet in Saltillo, capital of Coahuila, at an early date. It will be held under the auspices of Governor Espinosa Mireles, and it is expected that much good will result, as was the case with the first session.

At a meeting of the Council of Technical Education held recently in Mexico City, it was decided that the preparatory school for women should be supplied with all the elements for female education in various lines.

In the six months ended December 31, 1917, the national mint turned out ₱30,700,000 in gold and silver coin of various denominations.



ALASKA

JUNEAU.—Alaska Gold Mines Co. reports as follows for the four quarters of 1917:

	Fourth	Third	Second	First
Tons milled	532,699	523,871	642,683	541,093
Gross value, per ton	$1.06	$1.01	$1.112	$1.207
Yield	0.8608	0.8150	0.8988	0.997
Tailing	0.205	0.1915	0.2127	0.2102
Extraction, per cent	80.7	80.69	80.85	81.06
Value recovered	0.8608	$0.8150	$0.8988	$0.997
Net operating cost	0.7901	0.7983	0.7210	0.788
Profit per ton	0.0707	0.0167	0.1778	0.209
Value bullion and conc.	$458,545	$426,954	$577,616	$539,487
Profit	37,684	8,735	114,234	113,043

Charles Hayden, president, stated that, taking the year's operations as a whole, Alaska Gastineau earnings were sufficient to meet interest on debenture bonds and notes payable of Alaska Gold Mines. Earnings for the third and fourth quarters of the year were, however, at a rate considerably below the accruing interest requirements for the periods, and a continuance through 1918 of conditions that prevailed in those quarters would leave the company without necessary balance of income or available cash resources with which to continue payments of interest on its bonds. Last week it was decided not to pay interest due.

Alaska Juneau Gold M. Company's results during past 8 months were as under, according to 'Boston News Bureau:

Month 1917	Tons per day	Assay per ton	Extraction, %	Milling per ton	Mining per ton	General per ton
June	1,639	$0.8103	70.0	$0.713	$0.3660	$0.036
July	1,874	0.9610	76.0	0.651	0.2765	0.118
Aug.	2,486	1.2569	78.7	0.349	0.2509	0.065
Sept.	3,166	0.8868	74.8	0.421	0.2630	0.044
Oct.	3,326	0.9000	75.1	0.400	0.2100	0.039
Nov.	3,833	0.7700	72.7	0.330	0.2700	0.035
Dec.	3.274	0.7260	76.6	0.440	0.3000	0.044
1918						
Jan.	3,832	0.6640	73.0	0.353	0.2200	0.038

Average for period is:

Ore treated, tons	2,929
Assay, per ton	$0.859
Extracted	0.642
Total cost	0.737
Loss per ton	0.095

Improvements are under way to increase mill capacity to its rated capacity of 8000 tons daily.

ARIZONA

AJO.—Little Ajo company has finished No. 1 drill-hole at depth of 1720 ft. Some low-grade ore was cut. Another hole is to be put down.

BISBEE.—Shattuck-Arizona and Denn-Arizona copper companies are to be consolidated at an early date.

CHLORIDE.—Arizona Ore Reduction Co. has started its new mill here, and is shipping lead concentrate.

CLIFTON.—Arizona Copper Co. has about restored its operations to normal; Shannon Copper Co. is not as well advanced; nor is the Detroit Copper Co., at Morenci. These companies have had more to contend with in resumption than is generally realized.

COPPER BASIN.—Arizona Portland property has been formally taken over by the International Mines Syndicate. Three shifts of miners are to be employed, and a second power unit installed.

FLORENCE.—Grand Pacific has opened 7 ft. of up to 20% copper ore, and shipments are expected to commence April 1.

Queen Creek Copper Co.'s shaft is down 550 ft. in a 5-ft. vein of high-grade carbonate. Shaft will be sunk to 600 ft. Shipping is to commence in March.

Two feet of high-grade silver-copper-lead ore has been cut at 830-ft. point in adit of Fortuna Consolidated Co. Another 30 ft. or so must be driven before main orebody is reached. Considerable water is flowing.

GLOBE.—High-grade copper ore has been opened in the Copper Vault mine, near the Cole-Goodwin mine. Shares owned by the New Dominion Mining Co. have been ordered deposited with the State Corporation Commission.

Arizona Commercial has opened good ore at 1500 ft. depth.

Iron Cap has cut 50 ft. of 6% ore on 1000-ft. level.

HAYDEN.—Labor dispute at smelter of A. S. & R. Co. here has been settled, men returning to work under old conditions, although some organized under the State Federation of Labor. Strikers demanded 50c. per day increase for all classes. Settlement was due directly to investigation made by Joseph F. Myers, Federal Mediator. He found that the smelting company is bound by an unprofitable contract made with Ray Consolidated company for a long term of years, and that it would ship Ray concentrate to its El Paso plant if expense at Hayden were materially increased. Such shipments have been made during the 10 days the Hayden furnaces were cold, serving as an effective object lesson to the strikers.

JEROME.—Demand of miners and mechanics for a flat raise of $1 per day has been refused by the Federal Mediator, who thinks that living costs are not out of reason, but suggests that living conditions could be bettered by the companies.

Ore assaying 116 oz. silver, $4.13 gold, and 5.75% copper has been found in new 2½-ft. vein on surface of Verde Hub. Diamond-drilling has been suspended owing to cold weather.

OATMAN.—Gold Ore company has opened 16 ft. of $15 ore on 650-ft. level. From above 500-ft. level this vein produced 3000 tons of $14.50 ore that was treated at Gold Road mill in 1916. Reserves between 350 and 500 ft. are estimated from 15,000 to 20,000 tons. This plant has been leased by Gold Ore company, and will be ready to treat 50 tons daily by March 15. A. C. Werden is manager.

PHOENIX.—United Arizona Copper Mining & Smelting Co.'s property has been examined by A. H. Parker of this place. Mine is 32 miles south-east of Jerome, in the Copper Creek district of Yavapai county; also 35 miles south-east of the smelter at Humboldt. Country rock is granite or gneiss. Main shaft is down 660 ft. and is being sunk to 800 ft. Openings on the 150, 300, 460, and 620-ft. levels show considerable ore. At 620-ft. depth a large shoot of ore carrying copper, gold, silver, and molybdenite was opened. Near the centre of the lode is where molybdenite occurs, in the form of kidneys, ranging from 4 to 18 in. thick, the entire length of work done.

On the hanging wall some high-grade bornite glance and native copper shows in large quantities. Assays in copper are from 5 to 50% and 2 to 30% molybdenite. Gold and silver are sufficient to carry on all mining. The hanging wall of this vein is granite and the foot-wall porphyry. Property is equipped with modern hoist, air-compressor, and drills; also blacksmith-shop, tools, and buildings sufficient to care for employees.

RAY.—Ray Consolidated Copper Co. reports as follows for fourth quarter of 1917:

	Quarters			
	Fourth	Third	Second	First
Copper, pounds	21,071,874	21,656,342	22,255,598	21,813,772
Profit	$2,570,872	$687,001	$3,679,898	$3,476,578
Dividends	1,577,179	1,892,614	1,577,179	1,577,179
Surplus	993,693	1,205,613*	2,102,719	1,899,399

*Deficit.

SENATOR.—Breed property, owned by Alex Ratcliff, has been purchased by the New Mexico Land & Copper Co. for $15,000. Ore carries copper, gold, and silver.

TUCSON.—The four North Star claims in the Twin Buttes district have been sold to W. R. Ramsdell. Shaft on this property is down 110 ft. and is in 5% ore.

Contracts have been closed whereby the Douglas smelters are to take the full production of the Narragansett and Vulcan mines.

A strike of 12% copper and 42 oz. silver ore has been made at the Black Prince mine, 40 miles south of Tucson.

The 50 copper claims of the Mineral Hill Consolidated Copper Co., a Pittsburgh, Pennsylvania, corporation, are 20 miles from Tucson, on the road to Nogales. Development covers 10,000 ft. and shipments 60,000 tons of carbonate ore. Shipments ceased last July on account of smelter embargo. Sulphide ores are being developed. Main shaft is 500 ft. deep. Three other shafts are 200 to 300 ft. deep. At latter, orebody is said to be 100 ft. wide. Copper content is 4%. Mine is equipped with four Fairbanks-Morse gasoline engines and three of the Western Gas Engine Co. The Ingersoll-Rand air-compressors of 670 cu. ft. is run by a 120-hp. Western Gas engine. A 75-hp. Fairbanks-Morse, type Y, 50-kw. generator has lately been installed for generating power to run a 235-gal. per minute Deane pump placed at 500-ft. level. These improvements were furnished by Harron, Rickard & McCone of San Francisco. Owing to restrictions caused by the War, only 40 men are employed, against 125 to 150 formerly. Fred G. Farish is manager.

ARKANSAS

YELLVILLE.—Manganese deposits near Batesville are to be developed by J. C. Shepherd, prominent in Arkansas zinc and lead mining.

CALIFORNIA

Most active field developments, coupled with an alarming decline in storage, are the outstanding features of the Californian oil industry for the year 1917, according to R. P. McLaughlin, of State Mining Bureau. Daily production amounted to only 90% of consumption, which was the greatest on record, being about 12,000 bbl. per day greater than during 1916, when current production supplied less than 90% of consumption. Increased consumption reflects the general industrial activity of the Pacific Coast. Under normal conditions such an increase would be welcomed, but the problem now confronting the oil industry is to supply other dependent industries with power from a continually diminishing store. The California State Mining Bureau is particularly charged under the law with supervising the method by which wells are drilled to prevent further damage to the oilfields by flooding with water. Other agencies have been recently organized by the Federal Government to supervise distribution and use of oil throughout the United States. Price of crude oil at the wells rose during the first half of 1917 from 73 to 98c. per barrel. Cost of production—both labor and material—also rose during the year; and it yet remains to be seen whether the business of producing oil has been made more profitable than before. Contrary to common opinion, business of producing oil, which must not be confused with that of dealing in oil lands, has not in past years returned average profits commensurate with the risk involved. In view of unusual war conditions, a prophecy as to future prices would be hazardous. However, it would be difficult to advance reasons why prices should not be expected to fall. Considerable addition to the proved acreage was made by development of the Montebello field near Los Angeles, now showing from 800 to 1000 acres of proved land. Original discovery was made by the Standard Oil Co., and since then about a dozen other companies, both large and small, have entered the field. Several wells are flowing at the rate of over 1000 bbl. per day. Revised maps of the various oilfields are being prepared by the Mining Bureau. This work is being carried on as fast as other and more pressing work of the Oil Department permits. The past two years have witnessed many important additions to the various areas of proved oil land, and new maps should prove most useful. Maps will be in the form of blue-line prints, allowing for frequent revision and remarkably low selling price, which will merely cover the cost of blue printing.

Maps of the Santa Maria field have already been completed and may be obtained for 50c. each. Outlook for 1918 indicates unabated development activity in proved fields, and continued efforts to develop new oils. Undoubtedly there will be conditions causing a curtailment of consumption.

BARSTOW.—Strontianite deposits near this place are described by Adolph Knopf in Bulletin 660-I of the U. S. Geological Survey. The mineral occurs in the Mud hills, 10 miles



MAP SHOWING SITUATION OF STRONTIANITE DEPOSITS NEAR BARSTOW

north, at an altitude of 3000 to 4000 ft. It consists of 87% strontium carbonate and 10.25% calcium carbonate. The high-grade mineral is crystallized in slender needles, and the lower grade resembles fine-grained dense-gray limestone. No great quantity is available at any one point, but the number of places at which strontianite has been found is surprisingly large. Deep mining will be impracticable on account of the loose unconsolidated condition of the clays in which the deposits are enclosed. Strontium is largely used in the beet-sugar industry.

COPPER CITY.—Arps Copper Co. will resume work early in March.

ENGELS.—Preliminary statement of Engels Copper Co. for 1917 shows gross earnings of $1,307,123. Operations cost $717,116 and depreciation plus mine depletion $272,459, leaving $317,548. Dividends were $295,253. Balance from 1916 was

$377,915, and that for 1918 is $400,210. New mill, tram, air-compressors, shops, etc., cost $552,240, and completion of Indian Valley railway $179,000, a total of $731,240. Officers are Henry Engels, president; F. Klamp, vice-president; E. E. Paxton, general manager; and L. A. Bell, secretary.

GOTTSVILLE.—The Jack Clute property, near here, known as the Manzanita placer claim, recently leased by A. W. Boslough and Lewis G. Glieve of Ashland, Oregon, is being equipped with a 16-hp. gasoline engine and a 6-hp. engine and hoist. This is a drift mine and an old producer.

HORNBROOK.—Heavy rains for the past month have been a boon to placer mining throughout Siskiyou but has made roads impassable.

The Rancheria Mining Co.'s mines near Hornbrook are being operated by 12 men. Besides new equipment in the mill, an expensive flume has been completed to carry the water over the head of Wagner ditch to pump its tailing so as not to interfere with the Wagner ditch holdings.

The Hazel gold mine and mill near here resumed last week after being idle for over four years. It was re-equipped at large expense. Two shifts are operating in the mine and mill. A large body of rich ore is being opened.

INGOT.—Afterthought Copper Co. resumed work and the flotation plant will start about March 8. Thirty men are employed, and mine is in good physical condition.

KENNETT.—Friday-Lowden adit of Mammoth Copper Co. has cut main orebody.

Shasta King mine, under bond to U. S. Smelting Co. from Trinity Copper Co., employs 70 men, and ships 200 tons of ore daily to smelter at Kennett.

MARIPOSA.—Mountain King company is to deepen its 1400-ft. shaft to 2000 ft., and do extensive exploration. The mill is crushing good ore steadily.

Mount Gaines mine has a 100-hp. electric hoist installed, and mill overhauled.

At Ruth Pierce mine 35 men are employed, the mill crushing rich ore. High-grading is reported as prevalent.

MASONIC.—Tanawah property of M. A. McClain in Mono county has been sold to C. H. Ernst of Pacific Grove, California. Deal includes 10-stamp mill, cyanide plant, dwellings, water-rights, etc. Past gold output is said to total $1,000,000, but litigation kept mine closed for several years. Tanawah and United groups are to be merged by Colorado and Illinois people.

The Silverado continues shipments of high-grade ore.

PORTOLA.—Walker copper mine is yielding 85 tons of 6% ore daily. Shaft started from adit-level is 400 ft. deep, and ore-shoot is over 1000 ft. long.

RANDSBURG.—Miners and Claim-Owners' Convention held recently was a success, and another gathering is scheduled for April 15, 16, and 17. A protest was made against an attempt to extend boundaries of Sequoia National Park, as this would prevent development of mineral-bearing land adjoining the Park. California Blue Sky law was deprecated and deplored because of its alleged handicap to legitimate mining industries and driving capital from the State to seek investment elsewhere. Permanent officers of the Rand District Mining Association were elected as follows: president, H. D. Osdick; secretary, H. B. Watson; and treasurer, W. McLean.

REDDING.—U. S. Smelting, Refining & Mining Co. has shut-down its Sutro mine, near the Mammoth, laying off 30 men. This action was taken because the Shasta King mine, which is under option from the Trinity Copper Co., has doubled its daily output of ore. The company was receiving more ore at its smelter at Kennett than could be treated, so some of its properties had to be shut-down. The smelter has a daily capaciy of 800 tons.

Louis Gardella's No. 2 dredge on Clear creek, three miles below Redding, will be ready to start about March 15.

C. H. Mitchell is prospecting the Kleineberg ranch, two miles below Redding, with a Keystone drill to determine whether it will pay to dredge the ground. Ranch is at mouth of Oregon gulch, famous placer diggings in early days.

Ten-stamp mill on Texas mine in Old Diggings was burned in order to get at the old iron and machinery, which had been sold for junk. The mill was in ruins, being idle for nearly 20 years. There is now not a single stamp-mill at Old Diggings; once there were four.

SAN BERNARDINO.—Thirty-five specialists of the U. S. Geological Survey are examining nitrate deposits in Death Valley, under supervision of Hoyt S. Gale and G. R. Mansfield. The deposits occur within an area of five miles near Saratoga Springs, on the Tonopah & Tidewater railroad. The area was surficially prospected about 12 years ago by the Pacific Nitrates Co., when Barstow was the nearest railroad point. At that time considerable low-grade material was found, but the low price prevailing discouraged further work.

Ore deposit containing radium has been discovered by M. E. Cox and others of Los Angeles in the Black Mountain district, 32 miles east of Victorville. Lode near top of the mountain is 35 ft. wide, and numerous smaller veins ouctrop on the slope. A. N. Milner has reported favorably on the property, and preparations are being made for extensive work.

COLORADO

BLACKHAWK.—Red Cross M. M. & R. Co. has secured lease on Sub-Treasury mine. A mill will probably be erected by owner, the Coloma Mining Company.

BRECKENRIDGE.—Governor silver-gold mine, 7 miles south, is to be re-opened.

CRIPPLE CREEK.—Gold output of district in February was $869,582 from 82,284 tons of ore treated.

PUEBLO.—Colorado Fuel & Iron Co. reports for last quarter of 1917 gross revenue was $10,297,609, against $9,157,817, a year ago. Net earnings were $2,093,971, and net surplus $1,540,816.

SILVERTON.—Ore shipments from district during February totaled 40 carloads.

IDAHO

KETCHUM.—Stewart-Faucett syndicate is consolidating properties in Little Smoky district of Blaine county, southern Idaho. Carrie Leonard silver-lead mine, with past yield of $500,000, is included in the 18 claims. A 100-ton mill may be erected. District is 30 miles from Ketchum.

Silver Star property in Little Smoky district has been purchased by Rodsford and others of California. Ore carries silver, and low prices coupled with poor transportation facilities led to suspension of work.

MULLAN.—Men employed in this district number 1000, largely increased by recent resumption of work at Morning mine of Federal company.

Mayflower Mining & Development Co. is to resume work at its mine after 5 years suspension. An assessment has been levied. J. H. Foss is president.

PINE CREEK DISTRICT.—Ore shipments are impossible at present, and the date of resumption is unknown. Roads are in bad condition, and work on the new railway is indefinite. The district is dull as a result. Before winter the Douglas employed 80 men; now it has only two. The Marmion claim of this company is opening well, a recent development showing ore assaying 51% lead, 20.6% zinc, and 23.8 oz. silver per ton.

KANSAS

BAXTER.—Production of this and Treece district last week was 1173 tons blende and 519 tons lead, valued at $107,973.

Aksarben Mining Co. is to erect a mill on a lease of the Cooper land, near this place. John Voohees of Anita, Iowa, is president.

TREECE.—Commonwealth Lead & Zinc Co. is to erect a mill

near this place. Drills have opened a good deposit at 260-ft. depth.

De Armond Mining Co.'s 300-ton mill is ready for treatment of ore opened at 160 ft. M. M. De Armond is manager.

MICHIGAN

HOUGHTON.—Wolverine produced 350,957 lb. copper in January. Ore averaged 13.35 lb. per ton, lowest on record.

Mohawk produced 984,343 lb., ore yielding 20.18 lb. per ton.

Ahmeek is treating 4600 tons daily of 20-lb. ore.

Victoria Copper Mining Co.'s profit in 1917 was $97,419, compared with $153,905 in 1916. Production was 1,612,640 lb.

MISSOURI

GALENA.—Wayland Mining Co. has opened 25% blende at depth of 234 ft. Ore is 50 ft. thick. Production has been coming from 90-ft. depth. L. H. Phillips is manager. This deep drilling is likely to start other similar work in the district.

JOPLIN.—Production of Kansas-Oklahoma-Missouri region last week was 6352 tons blende, 80 tons calamine, and 1775 tons lead, averaging $54, $33, and $83 per ton, respectively. Total value was $496,544, making $3,618,885 for 8 weeks.

No. 2 mill of the Waco Mining Co., in the Waco-Lawton district commenced work two weeks ago. It has a capacity of 450 tons in 10 hours. Equipment includes an 18-in. breaker, one set of 42-in. rolls, two sets of 36-in. return rolls, and one set of 24-in. chat rolls. There is a six-cell rougher, with cells 36 by 48 inches in size, and a seven-cell cleaner-jig, with cells 34 by 42. The centre-drive system has been installed in the mill. There is an independent feed elevator, and independent tailing elevator for the sludge department, which holds 10 Wilfley tables and two slime-tables. Sand-tanks are used at present, but Dorr equipment probably will be added later. The mill proper is operated by a 14 by 42-in. Corliss steam engine, capacity being about 200 hp. Another Corliss engine, 11 by 30, furnishes power for the sludge department. A 600-cu. ft. Ingersoll-Rand cross-compound compressor is being installed, there being a smaller one already in use. The nature of the ground, however, does not call for great compressor capacity. The dump-pile at this mine is equal in size to any of the Oklahoma bonanza properties. Exceptionally rich 'dirt' is being taken out of No. 2 shaft at a depth of 122 ft. Shafts No. 1 and 3 are being sunk deeper. No. 1, which now is down 195 ft., will be put down to the 300-ft. level if this seems practical. No. 3 is now down about 100 ft. Within the past week another rich strike has been made by the company about 600 ft. from the mill, to the north-west, and another shaft will probably be sunk here. Surface tramming will be used for all the field shafts, mules being used at first and probably gasoline locomotives later if warranted. P. B. Butler is manager.

KLONDIKE.—On Aylar land, I. L. Burch and S. S. Cummings have put down six drill-holes, which show rich lead and zinc ore from 105 to 140-ft. depth. A shaft is to be sunk, followed by erection of a mill.

MONTANA

BANNACK.—C. W. Stalling, leasing the Hendricks gold mine here, has developed a fair quantity of $10 ore, and may erect a 5-stamp mill.

DUNKLEBERG.—In Bulletin 660-G, of the U. S. Geological Survey, J. T. Pardee describes this mining district of Granite county. This place is 50 miles north-west of Butte. Intermittent work during 30 years has yielded $200,000 in silver and lead. Lodes are generally narrow, and are simple quartz veins in fissures that follow inclined bedding planes, or cut across the sedimentary rocks and diorite sills. Silver-bearing galena and lead carbonate are the valuable minerals, although zinc blende is commonly present. The Wasa is the largest mine. Others are the Sunset, Pearl, Summit, Forest Rose, Hatta, and Jackson.

BUTTE.—Lexington zinc mine of Anaconda company resumed work last week, after being closed from May 1917. Normal ore output is up to 350 tons daily.

Butte & Superior Mining Co. reports as follows for fourth quarter of 1917:

	Quarters			
	Fourth	Third	Second	First
Ore milled tons..	126,175	60,106	126,737	148,935
Zinc, per cent....	15.76	15.14	15.304	15.491
Silver, ounces....	6.02	5.85	5.5830	5.7730
Zinc concentrate, pounds 37,741,179		17,396,952	75,340,000	85,042,000
Zinc, per cent....	48.77	47.55	46.509	47.131
Silver, ounces....	18.34	18.16	17.676	17.256
Mill recovery, per cent	94.84	95.62	90.329	86.821
Mining cost per ton	$5.73	$5.86	$4.7596	$4.6889
Milling cost per ton	2.48	2.52	2.4001	2.6496
Total cost per ton	$8.22	$8.38	$7.1597	$7.3385
Total income....$1,749,858		804,643	2,040,930	2,275,619
Profit	564,017	95,320	1,003,236	1,061,020

Average price used in estimating returns for spelter was 7½c. per pound.



MAP SHOWING SITUATION OF DUNKLEBERG DISTRICT, MONTANA

HELENA.—Helena mine in Grass Valley district has sent to smelter 45 carloads of silver-lead ore since the property was taken over by the Helena Mining Bureau a little over a year ago. Ore was stoped from above the 300-ft. level and is shipped direct to the smelter without sorting. Vein is over 2 ft. wide, and in places 10 ft. Negotiations are pending that may end in a sale of the mine. Spokane interests and local people have made offers.

One carload of gold-silver ore from the Gould placer has been shipped to the smelter. The ore is from a blind vein found while excavating for a reservoir.

Economy mine in Mitchell gulch has installed an electric pump. Ore is being blocked out for milling. Anson & Co. have opened a 25-ft. vein in Scratch Gravel hills. Ore, silver-gold-lead, is of milling grade, and some is being sorted for shipment to smelter.

Cruse Developing Co. is making regular shipments from the new shoot uncovered at the 640-ft. level.

B and G shaft of the Mountain States Mining Co. has been

re-timbered to the 50-ft. level and machinery has been ordered. When the new hoist and pumps are in place the shaft and levels are to be unwatered to the 250-ft. level, the lowest worked in the past.

A new strike of lead ore on 200-ft. level of Rock Rose mine assays $40 per ton.

Peerless Queen company is cross-cutting from the hanging to the foot-wall on the 300-ft. level.

NEVADA

Bullion.—A smelter is to be erected at this place in Elko county by William Patterson and J. D. McFarlane. F. G. Buick is engineer. It is said that there is enough ore in the district to keep the plant operating.

Ely.—Consolidated Coppermines company produced 1,128,925 lb. copper in January. In December, 24,000 tons of ore was treated.

Nevada Consolidated Copper Co. reports as follows for last quarter of 1917, compared with previous periods:

	Quarters			
	Fourth	Third	Second	First
Copper, pounds	22,153,158	20,217,673	20,817,356	18,852,321
Profit	$1,822,165	$1,988,323	$3,546,741	$3,238,474
Dividends	1,999,457	2,299,375	1,999,457	1,999,457
Depreciation, etc.	249,061	233,145	236,851	216,557
Surplus or deficit.	−426,353	−544,196	+1,311,542	+1,022,459

Cost of producing copper was 11.91c. per pound.

Goldfield.—Great Bend mine shows in stope 7 ft. of $55 to $330 ore. On 160-ft. level is $45 ore.

Winze below 400-ft. level of Red Hill Florence is down 35 ft. in rich ore. A drift has been started at this depth. Ore is to be shipped soon.

Tonopah.—Standard Oil Co. is constructing a spur from Scranton, on Tonopah & Tidewater railroad, to an extensive deposit of clay near Fairbanks Springs, in Amargosa valley. Property has been held under patent for 10 years. The clay is an excellent substitute for fuller's earth. Activity of company in this field caused oil excitement in Tonopah, Goldfield, and Pioneer, hundreds of locations being made in belief that the company had discovered oil.

Tonopah Divide Mining Co., in the Gold Mountain district, cut a vein on 270-ft. level at 160 ft.; it was 24 ft. wide, carrying gold, silver, and molybdenum. Last mineral occurs as wulfenite. Same condition exists on the lower level, cross-cut having penetrated 20 ft. without reaching the other wall.

Virginia City.—Under management of Whitman Symmes, development of the North End mines on the Comstock is proceeding on the largest scale in 20 years. Old workings are being repaired, and good ore has been exposed at several points in the deeper levels. Orebody recently discovered on the 2300-ft. level of the Union Con. has been opened for 130 ft. at a point 60 ft. below the 2400-ft. level, and shows greater strength there than at 2300 ft. Output is approximately $60,000 per month, and No. 2 dividend, at the rate of 5c. per share, will be paid March 1. Sufficient ore is stated to be exposed to insure numerous dividends, with a possibility of extra profits. Exploration to find the orebody on levels below 2400 ft. and above 2300 ft. are being made.

Sampling of veins at 2000 and 2100 ft. of the Ophir has been made, and preparations are in progress for extensive work at both points. Considerable $18 ore has been sent lately to the Mexican mill.

Driving north is proceeding from the 2500-ft. station of the Sierra Nevada on a promising shoot, while work is expected to intersect the main vein.

From the 2300 and 2900-ft. levels of the Mexican new work has started, with good ore exposed.

In the Con. Virginia principal attention is being devoted to the 2700-ft. level, where ore conditions are fair.

Installation of new equipment is progressing at the mill of the Jacket Con. Good ore continues to be drawn from the adit workings on Gold hill, and the mill is running at about 50% capacity.

Yerington.—Nevada-Douglas reports net profit of $22,493 from mining operations in January and $10,000 from Nevada Copper Belt railroad. Daily ore shipments to the Mason Valley smelter are now 250 tons, against 100 tons in December.

NEW MEXICO

Santa Rita.—Chino Copper Co. reports as follows for last quarter of 1917:

	Quarters			
	Fourth	Third	Second	First
Copper, pounds	20,266,715	21,887,390	20,546,593	19,225,111
Profit	$2,224,847	$963,409	$3,725,661	$2,912,698
Dividends	1,739,960	2,522,942	2,174,950	2,174,950
Surplus	542,207	1,478,417*	1,643,372	817,121

*Deficit.

OKLAHOMA

Douthat.—The Carnegie Milling Co. has bought the National Zinc & Lead Co.'s 300-ton mill at Webb City, Missouri, and is moving it to its lease near Douthat. P. L. Bucy of Bartlesville is president.

Picher.—Production of zinc-lead region last week was 3836 tons blende and 850 tons lead, valued at $282,999.

Quapaw.—Spelter Mining Co. plans erection of mill on a lease of Abrams land. J. J. Gurlach is president.

Miami-Ada Mining Co. in drilling passed through 42 ft. of ore, beginning at 190-ft. depth. J. M. Ramsay is president.

OREGON

Galice.—Gold Bar placer mines on Rogue river, below Galice, have been sold to Hayes Temple, Gust Fisher, and Alfred Eubanks, of Seattle, Washington. New owners are operating with three giants and a steam-shovel.

Gold Hill.—J. W. Davies and associates, lessees of the Cheney, Simmons, Haff, and Ray gold claims, 3 miles north, have opened rich ore at 400-ft. depth, enough to repay development and purchase-price—$100,000. The new shoot was found at end of a 900-ft. drift. Three years ago, Ray and Haff, lessees, discovered scheelite in the gold ore, the vein averaging 2% tungstic acid. Most work on the group is in the Cheney and Simmons claims, generally known as the Sylvanite mines, developed by the Sylvanite Mining Co. The lode contains quartz with pyrite; carrying gold and silver valued at $3 to $5 per ton. High-grade ore occurs in boulders, at a depth of 80 to 100 ft. Sulphide ore begins to appear at 160 ft., and the vein is 5 ft. wide at 225-ft. depth. The hanging wall is slate, and foot-wall limestone. Greatest depth attained on this lode is 600 ft., where it is 25 ft. wide.

UTAH

Bingham.—Utah Copper Co. reports as follows for last quarter of 1917:

	Quarters			
	Fourth	Third	Second	First
Copper, pounds	50,802,793	54,762,544	56,403,465	42,866,316
Operating profit	$8,117,812	$1,030,221	$8,898,628	$5,775,604
Other income	222,471	178,428	189,413	120,213
Nevada Cons. dividends	1,000,500	1,150,575	1,000,500	1,000,500
Bingham & Garfield dividends		475,000	475,000	350,000
Total available	$9,340,784	$2,834,225	$10,563,541	$7,246,318
Dividends	5,685,715	6,497,960	5,685,715	5,685,715
Surplus	3,655,069	3,663,734*	4,877,826	1,560,602

*Deficit.

Alta.—As the Red Bell Mining Co. wishes to haul ore down Big Cottonwood canyon by horse-drawn vehicles the City Com-

mission of Salt Lake City has refused permission on the grounds that the city's water supply would be contaminated. The company is very vexed at being treated thus.

AMERICAN FORK.—Pacific Mining Co. pays one cent per share on March 15. This is No. 3 dividend, equal to $4000. Mill is treating 150 tons daily.

EUREKA.—Profit of Eagle & Blue Bell Mining Co. in 1917 was $477,229 net, against $154,776 in 1916, $143,345 in 1915, and $121,536 in 1914.

Eureka Lily's first car of ore averaged 12% copper, 30 oz. silver, and a little gold, equal to $64.50 per ton. This came from depth of 1400 feet.

Tintic Standard has installed a 35,000-cu. ft. fan on its 1300-ft. level to improve ventilation. Shipments last week were 13 carloads.

Tintic Milling Co. is having difficulty in operating at capacity on account of ore-dumps being frozen. T. P. Holt is superintendent.

WASHINGTON

CHEWELAH.—Profit of United Copper M. Co. in 1917 was $113,000, equal to 11.3c. per share. Eleven monthly dividends of 1c. each absorbed $110,000. Ore and concentrate sales totaled $312,000, from 28,000 tons treated. Reserves increased by 116,000 tons. Shut-down of Trail smelter reduced output and dividends.

REPUBLIC.—Knob Hill Mining Co. during 1917 reported revenue from ore sold $102,143 net. Wages absorbed $46,800, and dividends $34,784. The shoot opened on the new level averages $16 gold per ton.

San Poil mine is to be explored at depth by diamond-drill, the Consolidated Mining & Smelting Co. of Canada to do this at 200, 400, and 700 ft. below the main adit.

CANADA

BRITISH COLUMBIA

GRAND FORKS.—Granby Consolidated's copper output in January was 3,383,496 lb. from Anyox and 825,897 lb. from Grand Forks, a total 4,209,393 lb., compared with 2,946,476 lb. a year ago, and 4,468,388 lb. in December.

SILVERTON.—Profit of Standard Silver-Lead company in December was $24,174, against $10,917 in November. Surplus at end of 1917 was $202,801. Zinc sales realized $57,382.

TRAIL.—New treatment charges by Consolidated Mine & Smelting Co. of Canada are giving operators in the Province considerable concern. They provide for a payment on ore containing not more than 4% zinc, 95% of the silver, and 90% of lead. With each increase of 1% zinc company will reduce the amount of silver it will pay for by ½ of 1%, and it will reduce the amount of lead it will pay for by 1%. Ore containing more than 25% zinc will not be accepted. If ore contains more than 0.05 oz. gold, 95% of the gold will be paid for at $20 per oz. An additional charge of 50c. per unit per dry ton of material, but not to exceed $4 per ton, will be made for sulphur in ore. A minimum deduction of ½ of 1% will be made for moisture. Flotation concentrates will be charged $1 extra per dry ton. Charges for smelting will be increased or decreased 25c. per ton whenever the cost of coke increases or decreases. The charges will be increased or decreased 1½c. per ton for each 1c. increase or decrease of change per shift in the wages paid.

A. I. M. E.

The next meeting of the San Francisco section is called for March 12, when W. W. Bradley, of the State Mining Bureau, will speak on new developments in the metallurgy of quicksilver. L. H. Duschak, of the U. S. Bureau of Mines, will lead the discussion. The meeting will be at the Engineers Club, 57 Post street, at 7:30, preceded by an informal dinner ($1) at 6:30.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

E. GYBBON SPILSBURY is in Cuba.

A. F. BENNETT is at Tucson, Arizona.

HENRY E. WOOD is at La Jolla, California.

E. V. DAVELER has returned to Thane, Alaska.

JAMES A. MCDONALD, of Tucson, is at the Palace hotel.

E. P. MATHEWSON, accompanied by E. F. W. SALISBURY, is here.

ROBERT A. KINZIE has returned from Sierra county, California.

F. W. DRAPER has returned from Russia to Allston, Massachusetts.

A. E. CARLTON, of Denver and Cripple Creek, was here during the week.

T. B. HASKINS is in the 158th Infantry at Camp Kearny, California.

D'ARCY WEATHERBE sailed from New York for Liverpool on February 26.

WILLIAM MACDONALD is again with the Olympic Mines Co., at Omco, Nevada.

LEWIS N. BAILEY is in the 4th U. S. Engineers at Camp Greene, North Carolina.

K. D. KOLIASNIKOFF, of the Kyshtim mine, is expected in San Francisco from Siberia.

E. H. CLAUSEN has returned to San Francisco from the Colorado mine, Philippine Islands.

IRVING S. MCREAVY has been appointed manager of the Temiskaming mine at Cobalt, Ontario.

ALFRED TELLAM has arrived from Yokohama, on his way from the Ridder mines, in the Altar, Siberia.

JOHN BALLOT is here to be present at the hearing of the flotation case before the Court of Appeals.

D. M. FOLSOM has been appointed Federal Oil Director for the Pacific Coast, acting under Mark L. Requa.

ANDREW M. TWEEDY, resident manager for the South American Mines Co., at Zaruma, in Ecuador, is expected here.

L. O. KELLOGG, superintendent, is acting as manager of the Zaruma gold mine, in Ecuador, in the absence of the manager.

J. PARKE CHANNING has been chosen president of the Engineering Council, the organization of national technical societies.

MILO S. KETCHUM, of the University of Colorado, is in West Virginia directing construction, under D. C. JACKLING, of the Government smokeless-powder plant.

ROBERT E. DYE, formerly superintendent of the Buffalo mill at Cobalt, is manager of the Teck-Hughes mine at Kirkland Lake, Ontario, succeeding W. LEDYARD.

Obituary

A. H. PURDUE, State Geologist for Tennessee, died at Nashville on December 12, 1917, as a result of an operation. He was a graduate of Stanford University, was 56 years old, and left a wife and two sons. His work in Tennessee was valuable.

HENRY KEHOE, mining engineer, died at Los Angeles on February 6. He had been actively engaged in mining for 30 years, in the early 'eighties in Arizona and northern Sonora, later in the Black Hills, Cripple Creek, and Rossland. As examining engineer for different American and Canadian companies he traveled extensively in Alaska, western Canada, Mexico, and Central America. For the past two years he has been in Arizona and southern California, leaving Spokane, Washington, in 1915. He was 55 years old.

THE METAL MARKET



METAL PRICES

San Francisco, March 5

Aluminum-dust (100-lb lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.90
Antimony, cents per pound	15.50
Antimony (wholesale), cents per pound	13.50
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67
Pig-lead, cents per pound	7.50— 8.50
Platinum, soft and hard metal, respectively, per ounce	$108— 116
Quicksilver, per flask of 75 lb	$110
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	17.50

Platinum prices as given above are nominal, as all crude unworked metal held by importers, jobbers, and wholesale dealers was ordered commandeered by the Federal government on February 28.

Bibliography of antimony—1909 to 1917—covering all articles and publications on this metal, has been prepared by Chung Yu Wang, of Hankow, China.

ORE PRICES

San Francisco, March 5

Antimony, 45% metal, per unit	$1.10
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.90— 1.05
Magnesite, crude, per ton	$8.00—10.00
Manganese, basis 40 to 44% Mn and 8% SiO_2, cents per unit	70.00—80.00
Tungsten, 60% WO_3, per unit	$24.00
Molybdenite, per lb., 85% MoS_2	$2.15

Manganese in New York is quoted at $1.20 per unit for 48% ore.

EASTERN METAL MARKET

(By wire from New York)

March 5.—Copper is featureless. Lead is quiet but firm. Spelter is inactive and easier. Platinum quotations are unobtainable on account of Government action.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Feb.	27	Jan. 22	89.29
"	28	" 29	87.35
Mch.	1	Feb. 5	86.62
"	2	" 12	85.93
"	3 Sunday	" 19	85.48
"	4	" 26	85.30
"	5	Mch. 5	85.12

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Feb.	27	Jan. 22	23.50
"	28	" 29	23.50
Mch.	1	Feb. 5	23.50
"	2	" 12	23.50
"	3 Sunday	" 19	23.50
"	4	" 26	23.50
"	5	Mch. 5	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	....	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Reports from Chino, Nevada, Ray, and Utah copper companies for the last quarter of 1917 show little change in production when compared with previous periods of last year, but operating profits are much greater than in the third quarter, when, for book-keeping purposes, the metal was calculated at a low price. Dividends decreased in two instances. Costs at Chino rose from 8.89c. per pound at the end of 1916 to 13.65c. a year later, at Ray from 9.77 to 13.84c., and at Utah from 7.50 to 12.80c. Regarding the other disseminated copper deposits, Inspiration and Miami suffered greatly on account of labor troubles, and even at this date are not at full capacity. United Verde Extension, operating a lode mine, reports gross sales of metal at $14,583,649, against $9,949,919 in 1916, but through extra taxes and depreciation, profits only rose from $6,938,101 to $8,258,147. Abstracts of the above-mentioned porphyry reports will be found on the news pages of this issue.

Old metals in New York are quoted as follows: copper, heavy and wire, nominal at 23½c.; brass, light and heavy, 12¼ to 17¼c.; brass turnings, 13 to 14c.; brass composition turnings, 19 to 20c.; lead, heavy, 6½c.; and zinc, 6c per pound.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Feb.	27	Jan. 22	6.98
"	28	" 29	7.00
Mch.	1	Feb. 5	7.00
"	2	" 12	7.00
"	3 Sunday	" 19	7.08
"	4	" 26	7.10
"	5	Mch. 5	7.33

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

Fluctuations in A. S. & R. Co.'s price of lead in New York since the beginning of 1917 are shown below, according to the 'American Metal Market':

1917		Cents per lb.
Opened		7.50
January 29	Advanced	0.50 to 8.00
February 9	"	0.50 " 8.50
March 2	"	0.50 " 9.00
May 2	"	0.50 " 9.50
May 17	"	0.50 " 10.00
June 6	"	0.50 " 10.50
June 8	"	0.50 " 11.00
August 29	Reduced	0.50 " 10.50
September 5	"	0.50 " 10.00
September 13	"	1.00 " 9.00
September 18	"	1.00 " 8.00
October 11	"	1.00 " 7.00
October 18	"	0.50 " 6.50
October 24	"	1.00 " 5.50
November 5	Advanced	0.50 " 6.00
November 7	"	0.25 " 6.25
1918		
January 3	"	0.25 " 6.50
January 11	"	0.25 " 6.75
February 11	"	0.25 " 7.00
February 26	"	0.25 " 7.25

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Feb.	27	Jan. 22	7.87
"	28	" 29	7.87
Mch.	1	Feb. 5	7.87
"	2	" 12	8.00
"	3 Sunday	" 19	8.00
"	4	" 26	8.00
"	5	Mch. 5	7.91

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Week ending			
Date		Feb. 19	115.00
Feb. 5	125.00	" 26	115.00
" 12	125.00	Mch. 5	110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	.....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	.....
Mch.	219.00	113.75	.....	Sept.	75.00	112.00	.....
Apr.	141.60	114.50	.....	Oct.	78.20	102.00	.....
May	90.00	104.00	.....	Nov.	79.50	103.50	.....
June	74.70	85.50	.....	Dec.	80.00	117.42	.....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	....	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Tin average for February is not available, but according to position, Banca metal is quoted at about 72 to 73½c., and Chinese 67½ to 70 cents.

Eastern Metal Market

New York, February 27.

All markets were closed in New York on Friday, Washington's birthday. Generally the demand for all metals is light.

Copper is featureless with conditions unchanged.

Tin is quiet with spot metal nominal.

Lead is a little more active and higher.

Zinc is extremely dull, and is being shaded.

Antimony is quiet and unchanged.

Steel-makers will confer in New York on March 1 preparatory to a meeting with Government representatives to consider the prices that are to prevail after April 1, the time set for a possible revision of the present fixed schedules. They ask for stabilized prices over a period of six to nine months after months of constant annoyances and steadily advancing costs. Iron and steel-works operations have steadily improved in the past week. The U. S. Steel Corporation now has 75% of blast-furnace capacity operating, as well as 85% of active ingot capacity and 80 to 85% in rolling-mills. Other companies have not fared as well.

COPPER

There is little interest in the copper market, and news of the usual market nature is impossible, with sales and distribution so tightly controlled by the Government and the Copper Producers' Committee. It is the same story each week—large quantities being absorbed by the Government and the Allies at the Government fixed price of 23.50c. per lb., with regular domestic consumers supplied at the same price if there is any metal available after war-needs are taken care of. It is claimed in some quarters that costs are advancing at Eastern refineries possibly so as to restrict earnings and perhaps the output also. Laborers in the refineries are constantly leaving to take more lucrative positions in shipbuilding plants and other Government work. Refinery workers are now getting 38c. per hour as compared with a normal wage of 23.50c. per hour. A refiner who discussed the conditions said, during the last week that, if a further advance in wages were to be made, the profit on the smelting of copper, lead, and zinc at Eastern works would practically disappear. It is likely that these considerations will come up when the price revision as of June 1 is taken up, and it will be used to argue for at least a 25 or 27c. price for copper. The copper exports for January, of 48,637 tons, compare with a monthly export of 40,311 tons in 1917—a year when the total was phenomenal. The refinery output of the country is estimated at 2,780,000,000 lb. per year, as compared with 1,778,000,000 lb. annually before the War.

Copper sheets, hot rolled, are quoted at 30 to 31.50c. per lb., at the mill, with cold rolled about 1c. per lb. higher. Copper wire is held at 26 to 27c. per lb., at the mill, for carloads.

TIN

Business is confined to off-grade tin and to future positions, there being very little spot tin available. The past week has been a quiet one, with no news-feature of interest. In off-grades a little business is reported as having been done, but the total sales did not involve large quantities. It is somewhat surprising to witness the extent to which consumers are readily absorbing off-grade material, such as Chinese tin. Not long ago they could not be influenced to consider it. As to Straits tin—there is nothing doing—even in futures. The policy is simply to look on, to wait, and to do nothing. The London market has advanced again to £319 10s. per ton, as against £316 a week ago for spot Straits. Arrivals have been fairly good, the total for the month, including yesterday, having been 1040 tons. It is estimated that there are 4900 tons afloat.

LEAD

The news feature of interest is another advance in the price of lead by the American Smelting & Refining Co. Yesterday this company raised its quotation ¼c. per lb. to 7.25c., New York, and this is the second advance in the last three weeks. The outside market also kept pace, and is quoted at 7.25c., New York, or 7.10c., St. Louis. More interest has been displayed in the market in the last week, and the demand is reported as picking up slowly. The strength of the market is due largely to the fact that transportation difficulties continue to interfere with the flow of metal to the market, though some here state that receipts from railroads have been better recently than in many weeks. That the price will go any higher, however, is not likely, according to responsible opinion.

ZINC

Outside of the large quantities of grade A and high-grade zinc which the Government and the Allies are buying each week or month, the market is lifeless and without interest. Production is reported as still being curtailed. Prime Western, for early delivery, is held at 7.75c., St. Louis, or 8c., New York, but this is being shaded slightly to 7.70c., St. Louis, on small and carload lots. Bids are being taken by the Government on 500 tons of grade C zinc, which is nearly the same as prime Western in quality, but otherwise inquiry is of no importance. Canada is inquiring for prompt and March shipments. Receipts of metal from the West are much better, due to the milder weather of the past two or three weeks.

ANTIMONY

The Government last week bought 130,000 lb. of antimony from the lowest bidder at 13.50c., New York, duty paid. This is the present quotation for prompt and March delivery but the market is very quiet.

ALUMINUM

Some regard the market for No. 1 virgin metal, 98 to 99% pure, as stronger at 37 to 39c., New York, for prompt and March delivery. This quotation is nominal, however, and has not been established by any sales.

ORES

Tungsten: A fair business for future delivery is reported in the past week. This refers largely to imports from South America and the Far East. Chinese ore from Hongkong can now be shipped to the United States if permitted by the British government. A Chicago house was offering Chinese tungsten ore in the East recently. Prices range from $20 to $26 per unit in 60% concentrates, according to quality. Ferro-tungsten is a little lower at $2.25 to $2.35 per lb. of contained tungsten.

Molybdenum: This is unchanged at $2.15 per lb. of MoS_2, with business confined to small quantities and the demand light.

Manganese: About 2000 tons of high-grade ore has been received from a South American country, which has not been a source of such ore previously. It contains 51% manganese, 0.007% phosphorus, 8.5% silica, and under 3% iron. More is under negotiation and on the way. A large steel company is converting it into ferro-manganese. Prices for high-grade ore still range from $1 to $1.30 per unit, tidewater or mine.

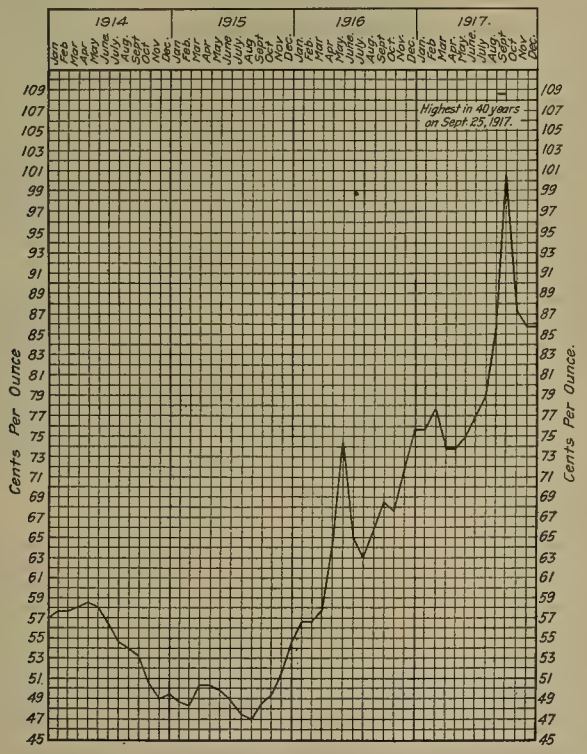
METAL PRICES in London at end of January were £125 per ton for electro copper, £29 10s. per ton for lead, £299 per ton for tin, and £54 per ton for zinc. These are official quotations.

Silver Market in 1917

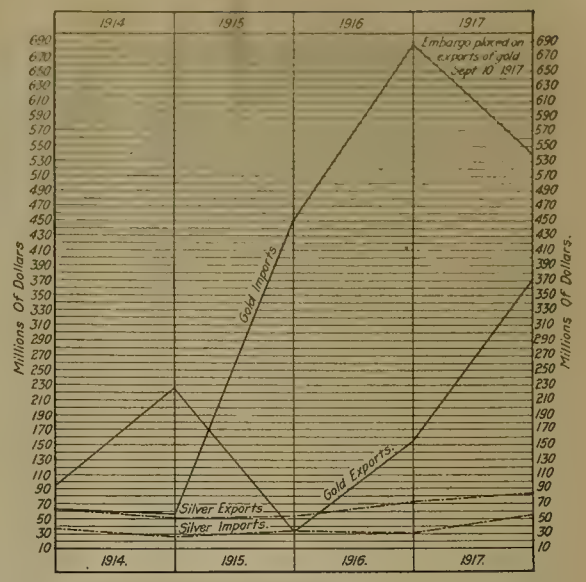
The 'Annual Bullion Letter' of Samuel Montagu & Co. of London has come to hand, and the following notes on silver are abstracted therefrom:

Factors influencing prices may be summarized as under:

Month	London pence	New York cents	Factor
January	36.682	75.630	Indian Mint as buyer most of the year
February	37.742	77.585	
March	36.423	73.861	Free China selling. Indian Bazaars 'bear' silver.
April	36.963	73.875	United States government buys for coinage.
May	37.939	74.745	Some Indian speculation.
June	39.065	76.971	General demand.
July	40.110	79.010	Indian bears cover, and Indian government took power to acquire private imports.
August	43.418	85.407	Entry of China into War, and loan to its Government.
September	50.920	100.740	Highest price reached since 1878.
October	44.324	87.332	Prohibition of export to certain neutral countries, save under license.
November	43.584	85.891	Foreign business restricted by war conditions.
December	43.067	85.960	Fair English trade demand.
Av. month	40.853	81.417	



Monthly Average Price of Silver for Four Years.



Exports and Imports of Gold and Silver in the United States during Four Years.

Early in 1917 the stability of the market was remarkable, creating confidence for the future. Subject to a slight upward inclination, prices remained about the opening quotation for the succeeding five months. By June, the market everywhere was well cleaned out of supplies, and so sensitive that it was ripe for an advance in price. In this month and July the trend was steadily upward, excepting a slight reaction on July 27. Then a remarkable advance commenced, which without a single set-back, carried the price on September 21 to 55 pence, or $1.085 per ounce, the highest since March 1878. The main factor in this extraordinary movement was the attempt of China to replace some of its currency which had been shipped abroad in large quantities during the year. China's entry into the War made the demand imperious. A spectacular fall followed this rise, due to a rumor that the United States government might dispose of part of its silver holdings, and the demand for China ceased. On October 30 there was a record drop of 3 pence, or 6 cents, down to 43 pence, or 86 cents, about where prices remained for some time. During the first two months of 1918, save an upward movement in the middle of January, there has been little change.

The Royal Mint's operations in silver coin in 1917 were £4,514,017, compared with £10,362,026 in 1916, £7,404,087 in 1915, and £1,247,720 in 1914. Withdrawals of coins during these periods were £191,695, £915,545, £145,457, and £602,045, respectively.

Gold and Silver Movements in 1917

The following statistics are from the 'Monthly Summary' published by the Department of Commerce, Washington, D. C., and the above chart was prepared from the figures given:

Year	Total	Silver Exports to China	England	Hongkong	India
1915	$53,598,884	$121,663	$38,907,765	$8,250,155	.....
1916	70,595,884	6,273,081	53,431,212	3,197,341	$2,384,467
1917	84,130,876	7,944,142*	25,725,720*	8,612,757*	17,133,899*

*10 months.

These figures show why England dominates the silver market, also the new movement of metal across the Pacific instead of the Atlantic.

SILVER IMPORTS FROM

Year	Total	Canada	Mexico	Peru
1915	$34,483,854	$6,701,583	$20,487,708	$4,544,124
1916	32,263,289	5,817,802	15,629,005	7,316,390
1917	53,340,832	5,526,042*	21,144,772*	5,817,761*

*10 months.

Most of the imports came in ore or in base bullion.

By April 1918 management expects to be treating 60,000 tons per month in its three plants. Surface dumps contain large quantities of ore, and in the mine ore estimated to be 3,000,000 tons of low-grade material available for the Independence mill. There has been a decrease in high-grade ore sent to the Colorado Springs plant, owing to lessened output of Cripple Creek, and unless there is a material increase in production of custom ores in the district it may become necessary, at no distant date, to close the Colorado Springs mill and treat at the Independence all the Portland high-grade ore, as well as the custom ore under contract. The Independence mill was arranged for treatment of rich ore if necessary.

GOLD EXPORTS TO

Year	Total	Canada	China	Cuba	Japan	Spain	South America
1915	$31,425,918	$11,587,395	$300,199	$14,026,380	$250,000	$50,000	$2,397,453
1916	155,792,927	8,611,424	5,207,343	28,659,250	26,131,826	16,988,383	37,597,178
1917	371,883,884	10,308,082*	.....	15,409,786*	155,467,726*	102,066,789*	49,541,870*

*10 months.

The increase to Japan and Spain is remarkable.

GOLD IMPORTS FROM

Year	Total	Australia	England	Canada	France	South America	West Indies
1915	$451,954,590	$34,019,181	$109,174,650	$218,910,742	$11,519,880	$15,940,752	$16,483,604
1916	685,990,234	15,519,050	57,131,507	579,337,169	38,829	9,847,141	9,917,421
1917	537,854,374	12,166,333*	6,332*	498,965,213*	23,845*	6,415,998*	144,244*

*10 months.

Canada has handled over $1,000,000,000 in gold for the Bank of England and Imperial Government since the War began.

Company Reports

PORTLAND GOLD MINING CO.

PROPERTY: mines and mills at Cripple Creek and mill at Colorado Springs.

OPERATING OFFICIALS: F. L. Smale, manager at mines; G. M. Taylor, manager at mills.

FINANCIAL STATEMENT: revenue in 1917 from bullion was $2,504,951, plus $22,569 from other sources. Costs totaled $1,864,266, leaving profit of $663,254. Balance at beginning of year was $341,753, and at end $278,383. Current assets are $595,421, and liabilities, $13,477.

DIVIDEND: paid in 1917 amounted to $360,000, making $10,957,080 to date.

DEVELOPMENT: amounted to 12,507 ft., making 323,357 ft. to date. No. 2 shaft was sunk 100 ft., and No. 20 level opened. Ore here is equal in value to the three levels above. Shoots 717 ft. long have been opened, with limits not reached. The Roosevelt drainage-tunnel reached Portland boundary, and a branch is being driven to No. 2 shaft. A small pumping-plant will be installed at this point when connections are made, making possible opening of several levels below.

PRODUCTION in 1917 was as under:

	Tons	Value	Total
Company ore shipped to Colorado Springs plant	56,272	$22.244	$1,251,723
Lessees' ore shipped to Colorado Springs plant	19,270	18.970	365,683
No. 1 reject to Victor mill	27,721	2.247	62,289
No. 2 reject to Victor mill	82,141	2.247	184,571
Ore from stopes to Victor mill	12,564	2.247	28,231
Ore from development to Victor mill	11,837	2.274	26,598
No. 2 dump ore to Victor mill	88,569	2.247	199,015
No. 1 reject to Independence mill	21,327	1,762	37,578
No. 1 dump ore to Independence mill	215,588	1.762	379,866
Totals and average	535,289	$4.737	$2,535,554

Production to end of 1917 was $46,580,602, contained in 3,372,605 tons of ore.

BARNES-KING DEVELOPMENT CO.

PROPERTY: four gold mines two at Kendall and two at Marysville, Fergus county, Montana.

OPERATING OFFICIALS: G. T. McGee, manager. At the North Moccasin: J. F. Reilly and C. A. Morgan in the office; T. W. Heatherly in the mine; A. E. Wordell in the mill; and E. G. R. Manwarring, assaying and engineering. At the Piegan-Gloster: J. H. McCormick in the mill; J. W. Rogers in the office; William McClean, engineering; and J. C. Hardy, assaying. At the Shannon: J. W. Johns in the mine, and F. L. Eccles in the office. And at the Kendall: A. B. Fox.

FINANCIAL STATEMENT: profit from operations in 1917 totaled $444,254. This, with $324,825, balance from 1916, made available the sum of $771,819. No. 3 dividend absorbed $40,000, leaving $731,819. Current assets at end of 1917 were $265,669, less $35,747 current liabilities.

DIVIDENDS: 10c. per share, equal to $40,000, was paid last year, and one of similar amount in February 1918. Total to date is $140,000.

DEVELOPMENT: North Moccasin mine has little ore in reserve. Work at the Kendall is by open-cut. In Piegan-Gloster 4565 ft. of work was done, and reserves are 3500 tons of $14 and 3200 tons of $12 ore. Shannon shaft is being sunk to 650 ft. depth. New openings totaled 1904 ft. Broken ore in stopes is 5000 tons of over $15 grade, and 1500 tons of similar material in pillars. Two options on other properties were given up.

PRODUCTION:

Mine	Tons	Value per ton	Bullion sales	Costs per ton
Kendall	7,923	$2.95	.....	.....
North Moccasin	26,790	8.53	$227,925	$6.006
Piegan-Gloster	20,525	10.43	210,311	7.991
Shannon	32,359	15.17	492,684	5.265

Expenses were reduced 30.1c. per ton at the North Moccasin and $1.229 at the Shannon, but increased just $10 at the Piegan-Gloster.

Reports are given in commendable detail.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

HELP LAUNCH A SHIP

*Who says we can't build ships?

Come on, you loyal American mechanics, masters of familiar trades, and brand this 'made in Germany' insinuation by building a bridge of ships to Pershing!

You can't do your country a greater service than by exchanging your good American brawn and skill for good American dollars—in the shipyards; and you'll do as much to win the War as the men dependent upon you in the trenches. Ships and men constitute the pivot on which the destiny of this country turns, and Uncle Sam is looking for 250,000 U. S. shipyard volunteers to build them.



THE MAN OF THE HOUR

Listen! Every rivet driven in the shipyards brings us nearer to the successful termination of the War. To do our share our shipbuilding program demands 6,000,000 tons per year, or over a thousand ships. We must have them in order to win. We must have them to keep the wheels of American industry moving and American labor employed in the factories.

The Shipping Board has the money, the materials, and the yards to carry out this 6,000,000-ton program, but it needs men to assure these thousand yearly launchings which will hurl their tidal wave toward Germany. There must be an immense reserve of earnest skilled labor to draw on as fast as plants are completed in the yards and the housing provided.

This, then, is the purpose of this message—to ask your enrollment as a shipyard volunteer, for work in the shipyards when needed. Back up Uncle Sam and the millions of your brother workmen by your enrollment.

This does not mean that you are to give up your regular job and rush off to some shipyard that, at the moment, may not be able to accommodate you. Your enrollment simply shows that you stand ready, when called upon, to do a particular job for a particular wage in a particular place. Everything will be in readiness for you, and you will lose no time. So highly does the Government think of your services that you are placed in a deferred class in the draft, as long as you are working on ships.



THIS IS YOUR BADGE OF HONOR—WEAR IT PROUDLY

"But," you say, "I've never worked on shipbuilding."

That's exactly why Germany thinks that America cannot build ships. Germany knows that there are not enough men in America who have actually worked on ships to make more than a tenth of the ships needed if we are to do any fighting worth while.

Here is where you American workmen can fool the Kaiser.

Ships are not things of mystery; they are merely big buildings afloat—the product of everyday skill and industry—and the American mechanic (hats off to him) can build them.

Familiar trades—your trade—are the ones that build ships; and almost all trades are represented. Two-thirds of the occupations required in shipbuilding are common to other industries, like boiler making, car building, bridge building, carpentering, and machine-shop work. The list given later indicates some of the classes needed. Read it carefully and see how you qualify. If you possess the right sort of train-

*Editorial of the Associated Business Papers, New York.

ing now is the time to rally round this movement and wear a Badge of Honor. This button, issued by the United States Shipping Board, shows that the wearer, through enrollment in the United States Shipyard Volunteers, has placed the welfare of the Nation above all else and stands ready by his labor to help throw across the seas a bridge of ships by which the armies of the United States can pass to do their duty on the fields of France. To wear this button is a sign of distinction. It truly stamps the owner as the man of the hour, in whose hands rest the happiness and security of every man, woman, and child in this country.

Come on men—250,000 of you! Your Government is asking that you answer the rattle of German machine guns with the rattle of the riveter. It is asking you, for the present, to prove that you are the marrow of Americanism by going on record with an expression of your willingness to help build ships where you are needed; and it meets you half-way with good wages.

Can you turn a deaf ear to the call? Where can you qualify in the following list?

The classes of skilled workers needed are the following:

Acetylene and electrical welders	Foundry workers
Asbestos workers	Laborers, all kinds
Blacksmiths	Loftsmen
Anglesmiths	Template makers
Drop-forge men	Machinists and machine hands, all sorts
Flange turners	Helpers
Furnace men	Painters
Boiler makers	Plumbers and pipe fitters
Riveters	Sheet-metal workers
Reamers	Coppersmiths
Carpenters	Shipfitters
Ship carpenters	Structural iron workers
Dock builders	Riveters
Chippers and calkers	Erectors
Electrical workers	Bolters up
Electricians	Other trades
Wiremen	Cementers
Crane operators	Crane men

Edward N. Hurley, head of the United States Shipping Board, is the mouthpiece of Uncle Sam in this call for shipyard volunteers. He has complete information on hand, ready to mail you, regarding method of enrollment and other details you may want to know. The coupon below is for your convenience in writing. Don't delay. Fill in the information asked for, clip and mail. Your action in this matter will bring you full particulars.

Show that you are interested by clipping the coupon now, while it is before you. The full story will then be mailed you.

Edward N. Hurley, Chairman,
U. S. Shipping Board,
Washington, D. C.

I wish you would send me at once further information, telling me how I can enroll as a member of the U. S. Shipyard Volunteers of the Public Service Reserve for employment in shipyards and so help win the War.

My Trade is .....

My Name is .....

Street Address .....

Town .....State.....

DUPLEX TRUCKS IN EASTERN BLIZZARDS

With snow banked on the Lansing, Michigan, streets two to three feet deep during the recent blizzard which swept the Middle West, Duplex 4-wheel drive trucks relieved the suffering in scores of coalless homes by delivering fuel when it was impossible for teams and sleighs to make headway through the snow-drifted highways. For two days and nights, the only means of coal delivery was with the Duplex trucks which the Duplex company placed at the disposal of the Lansing Fuel Committee. Coal was taken to the homes of poor and rich alike, baskets and bags of fuel being left on porches. Then the Duplex trucks would plow through the drifted streets to other homes, many of which were without fuel of any kind. While several Duplex trucks were delivering fuel, others were hauling street-cars which had been stalled for hours.

In its storm story, the 'Lansing State Journal' published the following statement: "When street-cars were held up this morning it began to look as if they would be frozen to the tracks until the next warm spell, but somebody thought of the Duplex 4-wheel drive trucks and a couple were hurried down from the factory. They hooked onto street-cars and plowed their way down the street. It took them about three minutes to cover the same distance that the street-cars, under their own power, had covered in three hours. All over the city the Duplex trucks answered the S. O. S. calls from stalled cars and gave them lifts. The big trucks seemed to be able to pull anything as long as they gould get a foothold."

H. M. Lee, president of the Duplex Truck Co., asserts that the dependability of Duplex trucks under most adverse weather and road conditions, was clearly demonstrated during the severe blizzard and snowstorm. He says: "The Duplex trucks were the only means of transporting fuel for nearly 48 hours, and the wonderful pulling power of the trucks was a surprise to some of our own drivers. The trucks not only plowed through snow-drifted streets, but hauled huge loads of fuel up steep grades to make deliveries in districts that were entirely without fuel. The local fuel committee informs me that but for our trucks many families would have suffered terribly."

COMMERCIAL PARAGRAPHS

The Stauffer Chemical Co. is erecting a $100,000 plant at Vernon, California, for the manufacture of hydrochloric acid.

Minerals Separation & Refining Co., of Manhattan Bdg., Chicago, recently installed a plant at Indiana Harbor, Indiana, and is operating a special process for refining ores and metallic residues. Company is particularly interested in refining tungsten.

Correction: Statement in this section of Mining and Scientific Press, issue of January 26, the paragraph 'Everything for Mine and Industrial Safety' is misleading. The Fleuss Proto apparatus, as described in the catalogue of the Mines Safety Appliance Co. of Pittsburgh, is no longer handled by that company as sub-agents for H. N. Elmer, general agent for North America; and can be obtained solely through H. N. Elmer, 1142 Monadnock Block, Chicago, Illinois; and E. D. Bullard, 288 Market street, San Francisco, California, his Pacific Coast representative.

Weldon G. Wilcox has been appointed advisory engineer of the Powdered Coal Engineering & Equipment Co. of Chicago. Mr. Wilcox is a graduate of Syracuse University, 1906, and of Wisconsin, 1909. From 1909 to 1911 he was in charge of research work at the University of Wisconsin, and from 1911 to 1913 was research chemist with the National Carbon Co., Cleveland, Ohio. He was production engineer with the Cleveland Electro-Metals Co. in 1913 and 1914, and from November 1914 until February 1 of this year was assistant superintendent of the Aluminum Company of America, at Massena, New York.

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Science has no enemy save the ignorant

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Tailing amounting to 20,000,000 tons is to be treated by this plant, and up to November last, 1,432,617 tons had been dealt with. Average metal content is 0.65% copper and 0.5 oz. silver. Silica content is 81% and sulphur 2.9%. De-slimed tailing, or sand, is roasted to 0.54% sulphur, equal to 0.26% as sulphate. Sulphuric acid is pumped on to the charge in vats, leaching proceeding in the ordinary manner. Most of the copper is in the form of chloride. Precipitation is by scrap-iron. Cement-copper contains 65 to 70% copper and 50 oz. silver per ton. Extraction is 74.27%, against 81.94% by analyses. *M. & S. P., March* 16, 1918.

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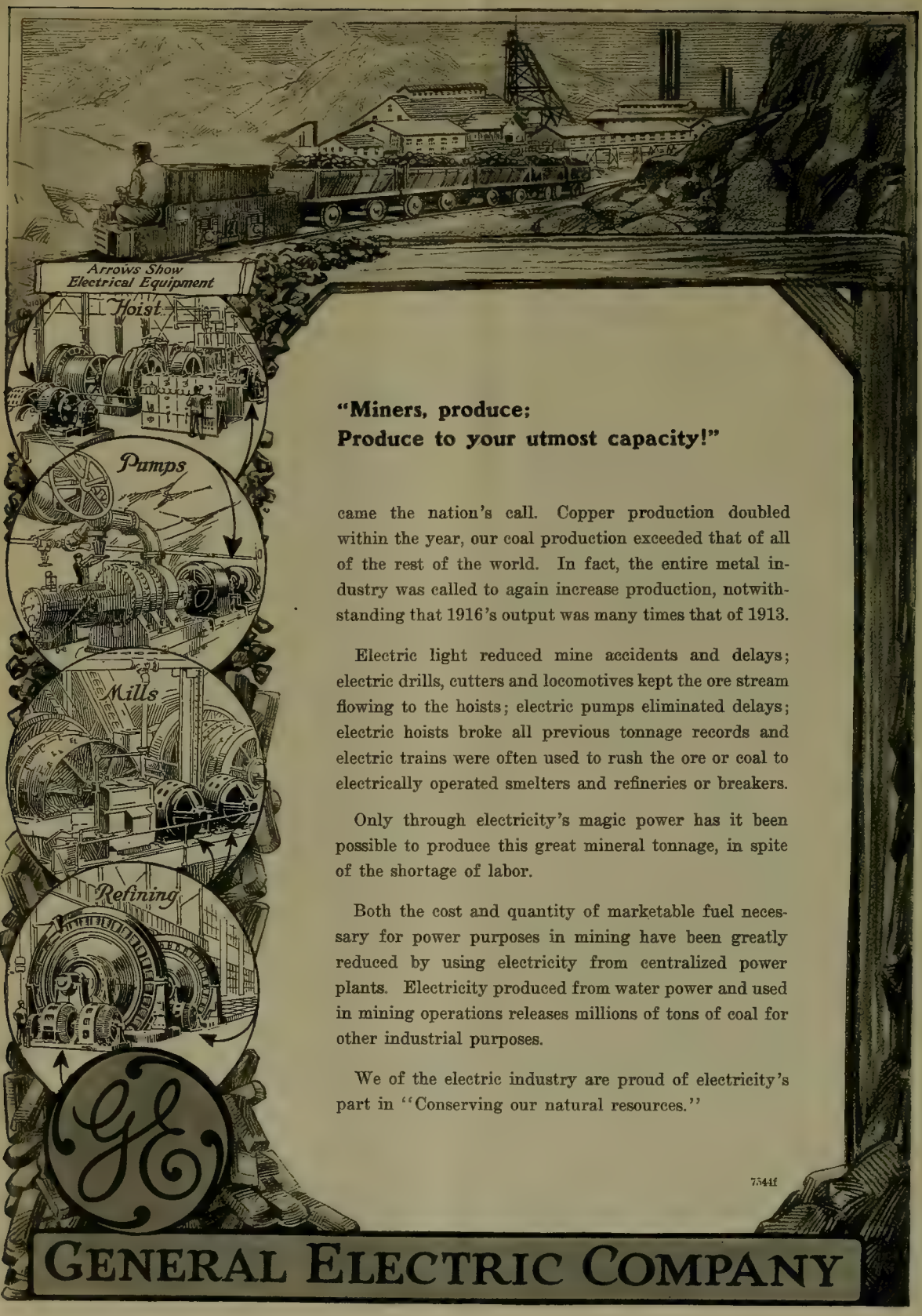
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**"Miners, produce;
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came the nation's call. Copper production doubled within the year, our coal production exceeded that of all of the rest of the world. In fact, the entire metal industry was called to again increase production, notwithstanding that 1916's output was many times that of 1913.

Electric light reduced mine accidents and delays; electric drills, cutters and locomotives kept the ore stream flowing to the hoists; electric pumps eliminated delays; electric hoists broke all previous tonnage records and electric trains were often used to rush the ore or coal to electrically operated smelters and refineries or breakers.

Only through electricity's magic power has it been possible to produce this great mineral tonnage, in spite of the shortage of labor.

Both the cost and quantity of marketable fuel necessary for power purposes in mining have been greatly reduced by using electricity from centralized power plants. Electricity produced from water power and used in mining operations releases millions of tons of coal for other industrial purposes.

We of the electric industry are proud of electricity's part in "Conserving our natural resources."

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EDITORIAL

HEARST wrote a characteristically impudent and sophomoric letter for use as an 'editorial' in his many organs of misinformation on March 8. He "cannot get so violently excited as some people over the possible effects in Europe of the present war." We have noticed that; he has no ranch in Europe. He pats the President on the back and says that "we ought to forget everything we have ever said against him." We do not forget some of the despicable things that Hearst has said, the rankly disloyal suggestions he has made, the malicious meanness of his prostituted journalism.

FERRO-MANGANESE is selling at $250 per ton for the domestic product. Consumption is greater than the supply, and new sources of the alloy are important. The latest producer is the Anaconda Copper Mining Co., which is to commence within five months. Five furnaces are being constructed at Great Falls, each to reduce 250 tons of manganese ore daily, making a total of 90 tons of ferro-manganese. This product will go into 10,000 tons of iron per day at Eastern steel works. It will also release 100,000 tons of shipping per annum, now engaged in carrying manganese from Central and South America to the United States. Ore will be mined from Anaconda's Butte properties and adjacent districts. Cheap electric power is available from the Montana Power Co., which is an important factor in the mining industry of Montana. What type of electric furnace is to be used in making the alloy is not known yet. Thus Anaconda adds to its metallurgical triumphs of huge blast and reverberatory-furnaces, reduction works, electrolytic copper and zinc, and precious metals; rivaling in variety of products the works at Trail, British Columbia.

PRODUCERS of copper are looking anxiously to the next price-fixing date in June. They failed to obtain an increase above 23½ cents when the price was adjusted a few weeks ago. The fact of an increased output at the Government figure weighed against their petition for better terms, although the argument was valid only in so far as it indicated that the mines were not being operated at a loss. A new factor has now been introduced, and it may prove important. The general increase in wages and in the prices of supplies has affected refineries as well as mines and smelters, but no higher charge for refining has appeared as yet in the estimates of cost for producing the finished metal of commerce. The refining is done under contract with the producers, the agreements usually being made for a long term of years. Although the mining companies to a large extent are interested financially in the refineries, this does not alter the fact that this expense is a direct charge against their output, and the claim is urged that refining now costs nearly three-fourths of a cent per pound more than it did before the War. It is said that the refining cost per ton of blister copper has risen from $17 per ton one year ago to $23 at the present time. In consequence the refining companies have announced that the rate must be advanced, or the works will be forced to close. The demand of labor for better wages, stimulated by the prevalence of the custom of manufacturing on the basis of cost plus 10%, has intensified the difficulty of maintaining an efficient force, and it can be met only by raising the rate on the copper treated. The producers are expected to concede the necessary increase, thus diminishing their profit for the present. Their action would appear to be justifiable, and may be regarded by the Government as warranting an increase in the official price of the metal.

BINOCULARS and field-glasses are so urgently needed by the Navy that a second appeal has been issued to the public to turn over such instruments, in exchange for which a nominal price of one dollar will be paid, and a receipt will be given by the Assistant Secretary of the Navy. If not destroyed the glasses will be returned at the end of the War with marks of service upon them that will give them enhanced value as precious memorials of the great struggle for freedom. The art of making lenses had not been cultivated extensively in this country in the past, so that competent workmen and the necessary equipment are not available for meeting the extraordinary needs of the moment. Although every factory in the United States and France is working at full capacity, thousands of officers will be without the aid of suitable field-glasses for watching against the attack of the Enemy unless our people make a prompt and wholehearted response. When the imperative necessity is understood no one possessing suitable instruments will fail to render this contribution to help in protecting those that risk their lives in the service of the Nation.

The Flotation Appeal

"A tired man": these were the last words of the learned counsel for the Appellant when concluding his argument before the U. S. Circuit Court of Appeals for the Ninth Circuit in San Francisco on March 8. Most of those that had listened for five hours to the technical debate were likewise weary, but it was the weariness of long-sustained interest, not boredom. Half an hour before the judges arrived every seat in the small chamber was taken and the space behind the rail was crowded. The audience, necessarily small, was representative; besides the array of legal talent, we noted Mr. John Ballot, chairman of Minerals Separation, supported by Messrs. Seth Gregory, E. H. Nutter, A. H. Higgins, G. A. Chapman, and W. M. Grosvenor. The Appellant's side of the controversy, aside from the attorneys, was represented by Messrs. N. Bruce MacKelvie, James L. Bruce, B. H. Dosenbach, and E. W. Engelmann. Mr. D. C. Jackling, although in town, was absent. Among the onlookers were E. P. Mathewson, Thomas J. Barbour, R. B. Yerxa, and Dudley H. Norris. Several elderly men of the prospector type suggested the miner's stake in the contest. Punctually at 10:30 the three judges filed into court; they were William W. Morrow, Erskine M. Ross, and William H. Hunt. Judge Ross, the only one of the three that had sat in the Hyde appeal, presided.

Mr. J. Edgar Bull opened for the Appellant [Defendant], the Butte & Superior Mining Company. A veteran, he spoke without waste of energy, clearly, and quietly. To each judge he handed a copy of patent 835,120. He began with a frank acceptance of the decision of the Supreme Court of the United States, in the Hyde case, as "the law of the land." His clients had used the prohibited fraction of 1% of oil before that decision, but since then always more than half of 1%, and latterly more than 1%. He contended that the use of any proportion above 0.5% did not infringe the patent as construed by the court of last resort. Turning to the text of the patent, he divided the claims into those specifying "a fraction of 1%" and those mentioning "a small quantity." No. 9, 10, and 11 were the 'small quantity' claims. Before reviewing the decisions of the successive courts, he gave to each judge a reprint of the previous opinions for convenience of reference. Emphasis was placed on the limitation of the quantity of oil as being the essence of the invention. He read paragraphs from the opinions in support of this contention. The Supreme Court had agreed with "your Honors" except as to the patentability of this limitation of oil, whereas Judge Bourquin, of the Montana court [from whose decision the present appeal is taken], had reaffirmed his opinion in the Hyde case, even going so far as to repeat the errors condemned by the Supreme Court. To what fraction of 1% does the Supreme Court limit the patent? To one-half of 1%. The Court said that "the patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions' 'amounting to a fraction of 1% on the ore'." The critical quantity is usually one-tenth of 1%, sometimes up to half of 1%, but never more. Here Judge Morrow asked for a definition of 'critical quantity.' Then came quotations from statements by the patentees, their witnesses and counsel, to show how they had agreed in limiting the critical proportion to less than half of 1%. Mr. Bull read the colloquy between Justice McReynolds and Mr. Kenyon [given in the brief, which appears on another page of this issue], whereat Mr. Kenyon gave signs of discomfort. Judge Bourquin's view that an excess included a fraction would be tenable if the patentees had been the first to use oil in flotation, but not if their invention was the use of a limited quantity, for the 'small quantity,' down to 1%, was old. Shall the public be denied the right to do what it had done before the patent? The decision below had ignored the Supreme Court's opinion on the 'small quantity' claims. The Appellant company used more than 1% because the Supreme Court compelled it to use more than half of 1%. "A burnt child dreads the fire." It had lost a million dollars per annum by using an excess of oil. Apparently Minerals Separation had abandoned the contention that mineral oil was "inert and useless," for their licensees use it in their oil-mixtures. Mineral oil is not a froth-producer, they contend, but this is contradicted by their own patent, in which they designate the oil as "an oily liquid having a preferential affinity for metalliferous matter." It is admitted by them that mineral oils have a greater 'affinity' than vegetal oils. Nor is it true that mineral oils have no froth-producing qualities. Mr. Bull cited from Minerals Separation reports and patents. The mention of oleic acid brought the question from Judge Hunt: "What is oleic acid?" We recalled hearing the same query made in a cracked voice by old Lord Halsbury when the Judicial Committee of the Privy Council was trying the Elmore v. Minerals Separation case in November 1913. This question in the midst of a flotation trial is as pathetic as Pilate's "What is truth?" Then Judge Morrow asked, "Is there a difference in the affinity of oils for minerals?" Mr. Bull replied affirmatively, adding that this applied to mineral and vegetal oils alike. It is a matter of 'cut and try.' Whereupon the same Judge asked, "The production of froth and the affinity for minerals are different qualities?" "Yes, your Honor." Both qualities are needed. Mr. Bull took pains to establish the function of the mineral oil, and, having done this, he proceeded to discuss the disclaimer filed by Minerals Separation after the Supreme Court had invalidated claims 9, 10, and 11 (the 'small quantity' claims) of the patent. The Supreme Court had found the patent good in part and bad in part; the disclaimer was to relinquish the over-claim. Plaintiffs [Appellees], Mr. Bull argued, had not made a proper disclaimer, they still claimed the use of more than 1% where results were the same as when using less than 1%. The disclaimer did not conform to the order of the Su-

preme Court. Mr. Bull had spoken for an hour and a half. As soon as he finished, the reading-desk, facing the judges, was cleared of his documents, to make room for those of Mr. Henry D. Williams, who opened for Minerals Separation.

Mr. Williams spoke with jaunty confidence, reading a large part of his speech. "The text of the Appellees will be the Supreme Court decision." Only a part of that decision had been read. As in the celebrated telephone case, where a tightening of a screw by Bell had converted a machine that could not convey speech into one that could—creating a new art—so "the final step" that the patentees of 835,120 had taken had been the step in the right direction. He gave an excellent non-technical description of the agitation-froth process. Without a modifying agent—namely, oil—the air would be ineffective in forming a persistent froth, the bubbles would coalesce and burst. The oil maintains the integrity of the little bubbles, so that they do not coalesce but repel each other and rise to make a layer of froth seven inches to three feet thick. Has the Appellant company carried on this process and obtained this result? It admits that it did up to January 1917. What change has it made in its procedure since then, in order to pass from an infringing into a non-infringing operation? Its procedure is the same, but it has added other oils that do not form mineral-froth. It has impaired the patent to the tune of a million dollars per annum. The process is applicable to ores having a metallic lustre, like graphite. All oils have a preferential affinity for metalliferous minerals. The patent covers substances other than oil that have this preferential affinity. It is necessary to make a preliminary test to select the oily substance most suited to the work. Here Mr. Williams handed the judges separate copies of each of the previous decisions. The formation of a froth is the end and object of the first three claims of the patent. The use of an oily substance that does not form a froth is alien to these claims, but any alien oily substance that does not interfere with the making of froth is included. Then followed a recital of the proportions and kinds of oil used by the Butte & Superior in 1916 and early in 1917. With oleic acid half of 1% was the point at which the Cattermole granulation ceased, and the process of 835,120 commenced. Claim 12 differs from No. 9, 10, and 11 in specifying both the quantity of oil and the agitation required to form an oil-coated mineral in the froth. "The Supreme Court said we must confine ourselves to the fractional proportions, so we wrote a disclaimer and wrote into the claims the language of the Supreme Court, but for the purposes of the case at bar we do not care whether they are limited to 1% or more, for they have infringed in using the oil of the patent in the proportion of a small fraction of 1% on the ore." It was now 12:30 and the Court adjourned until 2. On resuming, Mr. Williams argued that throughout the Supreme Court's decision there was an insistence on the "resulting froth-concentrate" as identifying the invention. Emphasis was placed on the novel "results," the novelty consisting in the use of an air-lift instead of the oil-lift of prior attempts, the carrying of the metal particles by air-froth in contradistinction to an oil-float. The reference to an "agitation greater than and different from" that which had gone before was a criticism of the things done by the Appellant with prior-art methods, all done with a violence of agitation unnecessary even in the process in suit. It was Cattermole that introduced violent agitation into oil processes. The Cattermole method was the immediate predecessor of patent 835,120. The colloquy quoted between Justice McReynolds and Mr. Kenyon referred to Broken Hill ore and oleic acid, nothing more. With the Cattermole process it was customary to use kerosene and heavy petroleum until oleic acid was introduced for saponification. On Broken Hill ore petroleum and kerosene would not produce a froth. The varieties of ore are infinite. Preliminary tests are necessary. Mineral oil is not essential to the process in suit.

The argument for the Appellees was continued by Mr. William H. Kenyon. He spoke in a staccato manner and gesticulated nervously. Both sides agree, he said, that this Court had only to read and study the opinion of the Supreme Court. What is the duty that the oil performs in this patent? Is it preferential affinity, or must one go further and inquire whether it has a froth-making capacity? "Does degree of agitation enter into the making of froth?" asks Judge Morrow. "Yes, somewhat," is the reply. "We introduced a special kind of agitation." The Supreme Court recognized that the preferential affinity and consequent coating with oil was old—Haynes patent; that the enhancing of that affinity by acid was old—Everson; that increase of buoyancy was old—Kirby; that increasing the stickiness of the oil was old—Cattermole; but utilizing the froth-forming capacity of the oil was new. The Court below held the same, limiting the fraction of 1% to "beneficial service." The Appellant used only a small fraction of 1% of the oil, pine-oil, that has the froth-making capacity; to evade the patent he added nine-tenths of 1% of oil that won't and can't form froth. Mr. Kenyon then proceeded to rebut the argument that the extra oil used could form a froth. He quoted Higgins's experiments to prove the inefficiency of mineral oil; also Janney and Bancroft to show that kerosene is not a 'frothing-oil.' At this stage the dispute waxes warm. Reference is made to an eleventh-hour introduction of evidence as to froth-making efficiency of mineral oils by the Appellant. "Our invention," shouts Mr. Kenyon, "came out of the blue while economizing oil in the Cattermole process. A significant admission—that of economy. It was interesting to note the unhappiness of counsel compelled to listen to the argument of their opponents. Their faces were flushed and they showed uneasiness. All of these manifestations were transferred to the other side when their turn to argue came. Mr. Kenyon quoted Higgins's testimony that he [Higgins] was "never able to get mineral-froth with kerosene." He is interrupted by

Mr. Thomas F. Sheridan, leading counsel on the other side, when he states that fuel-oil always contains some of "our soluble frothing-agent," this being claimed to be outside the record. Mr. Kenyon proceeds to smash the testimony given as to the use of fuel-oil at the Arthur plant of the Utah Copper Company, on the admission that the tanks were not cleaned properly before the experiments. Thus he appears to get even for his unfortunate colloquy with Justice McReynolds. The addition of nine-tenths of 1% of petroleum oil does not avoid the patent, he insists. It is not like the acid, or the fine grinding, or the copper sulphate used by the Defendant; it does not create the result, if it does anything; it does not make the mineral-bearing froth. Here he stopped abruptly, and Mr. Lindley M. Garrison was about to close the argument for Minerals Separation when Judge Ross announced that 15 minutes more would be granted to each side, whereupon Mr. Kenyon resumed. The Appellant does not claim any process of the prior art as his method, only the quantity of oil used. The Supreme Court holds that oil processes do operate in the same way, apart from limitations of oil. "We lose a million dollars by use of a process," says the Appellant, "therefore it cannot be the process defined by the Supreme Court." Columbus sought the East and found the West, yet he made a great discovery. While the plaintiffs were muddling over Cattermole's process they made a great invention based on the preference of air for oiled mineral. A distinguishing feature of the Supreme Court's decision is the emphasis on the "results obtained" as a limitation to the use of the patent. Infringement is involved in using a fraction above or below 1%, if those results are obtained, however camouflaged by dummy oil. He stopped. The Court granted half an hour more.

Mr. Garrison came forward. The ex-Secretary of War looks, acts, and speaks like a successful politician. He speaks loudly, gesticulates freely, slaps the desk liberally, and moves to and fro, barely refraining from looking away from the judges to the spectators. He does not say 'Your Honors' and 'May it please the Court,' but just plain 'You,' evidently deeming himself absolved from the minor courtesies. His only previous appearance in flotation litigation had been before the Supreme Court in the Hyde case. The Supreme Court did not disagree, he begins, with this Court on a question of law, but on a question of fact. Its decision did not turn on economy in the use of oil, but on a new function of the oil never before disclosed, namely, the frothing quality. "If you haven't got a frothing oil you can't get a mineral froth—take water, ore, and oil, and mix them as much as you like." He slaps the desk with gusto. All oils have a preferential affinity for minerals. Select the ones that make froth. None of the mineral oils used by the Appellants will make froth and carry on the process of the patent in suit. None of the oils included in the patent if used to over 1% will produce the result desired in the mill. Appellant uses an oil of the patent plus other oils. The Hyde case did not include any operation except with the oils of the patent. If the use of the prior art gives the same result it is not our process; if it gives a different result, it is.

Mr. Garrison was followed by Mr. Frederick P. Fish, who closed for the Butte & Superior. Mr. Fish is short-sighted, physically, not mentally; and had a little difficulty in finding his citations. At one point, early in his speech, he was momentarily confused, but his quietly serious manner of discussion was restful after the declamatory style of his predecessor. Mr. Fish did not indulge in gesticulation or rhetorical confectionery; he restricted himself to simple direct statement. The decision of the Supreme Court, he said, is a clear document, so that its meaning cannot be clouded. Claims 9, 10, and 11 are declared invalid, because those claims were not for the specific thing that the Court found to be new, namely, the use of oil in 'critical quantity.' It was an apt phrase to cover one-tenth or five-tenths of 1%. The invention does not go a step beyond that critical point, as determined by the testimony, not by the patent alone. Can the patent stand if it claims all oils, animal, vegetal, and mineral, when you have to hunt through the universe to find the oil that will do the work specified, without stating how you are to select the oil adapted to the particular ore? He quoted from Sulman's testimony to show how much had been done before the discovery was made. The step was a short one. There had been froth in the Cattermole process always. He quoted the Higgins record. At 3% "very little float," and so forth, until the 'float,' or 'froth,' became "vastly increased" at 0.32%. The invention was purely a modification of Cattermole's. The same old froth is made whenever oil and water come together. The same froth was made under less fortunate conditions by Everson, Froment, and Kirby. The new froth differs from the old because there is less oil to coagulate. The froth differs with the proportion of oil. The Supreme Court says that a perfectly definite discovery was made in ascertaining that when you run down oil to the vanishing point you get a new phenomenon—no more granulation, but froth at its maximum efficiency at one-tenth of 1%. Litigation has grown up to beat the exigencies of each case. There is nothing in the patent to warrant the claim based on "our kind of froth." In the British specifications of the patent the phrase "a small fraction of 1%" is used, indicating what "a fraction of 1%" was intended to mean. Mr. Fish quoted Chandler's testimony on the subject, showing that one to four pounds is the practical range according to Minerals Separation. "We have the right," said Mr. Fish, "to pay a million in order not to use the patent rather than pay ridiculous charges."

By request of the Court a moving-picture exposition of flotation was given the following evening, supplemented, on the Monday following, by a demonstration with experiments. An account of these proceedings must be deferred.



Compañia de Minerales y Metales

The Editor:

Sir—On March 15, 1917, I had occasion to write you calling your attention to certain erroneous statements published in your magazine of February 17 under the heading of 'Correspondence from El Paso.' You were good enough to publish my letter of explanation in full in your April 7 issue, which we greatly appreciated, as it contained a statement of the facts.

In your issue of September 15, another article appeared which likewise contained several inaccurate and misleading statements with reference to our subsidiary companies in Mexico. At that time I dictated another letter to you, setting forth the facts, but did not send it, thinking that your article was based upon misinformation and had no ulterior motive. It seemed undesirable, therefore, for me to reply at length to the article for fear of treating too seriously a matter which was in fact only of interest to a limited circle.

However, my attention has now been called to the article in your issue of February 9, entitled 'Mexican Mining Law.' This article does not confine itself to a mere statement of inaccuracies, but seems to be permeated with a distinctly unfriendly spirit. From our long and friendly acquaintance I take it for granted that you desire to publish in your magazine only the truth and that this article as well as the ones which have preceded it, in which reference has been made to our subsidiary companies in Mexico, has been based upon the information available to you and that you had reason to believe this information to be reliable. Therefore it naturally follows that if I can show you where your informant has misled you and has submitted statements to you which are contrary to the facts, you will be ready to make the necessary corrections. The inaccuracies to which we particularly take exception are the following:

1. The Compañia de Minerales y Metales, which is the company through which we manage most of our Mexican properties, is not "German owned," as you state. The fact is that the American Metal Co. owns 97.7% of the stock of the Minerales company.

2. Your article contains the insinuation that the properties which we have recently acquired in Mexico have been in some way secured by unfair methods or by improper co-operation with the Mexican government as a result of the mining laws recently enacted in that republic. This we absolutely and unequivocally deny. It is true that we have acquired several properties in Mexico during the past three years, but we have never acquired any property or any interest in any property which was confiscated by the Mexican government or the sale of which was forced by the intervention of that government. We have in every case acquired property by direct purchase from the owners or by the purchase of stock in the open market where the property was owned by a corporation. Our records of these transactions are open for your inspection if you desire to verify this statement.

3. Your insinuation that our vice-president, Mr. Henry Bruère, had anything whatever to do with the management of our property in Mexico, and the suggestion of any change in the policy of the Mexican government which would redound to our advantage are absolutely without foundation. Mr. Bruère went to Mexico at the invitation of the Carranza government to act as its financial advisor in the reorganization of some of its departments. His acceptance of the invitation was with the full knowledge of our own Government, and while in Mexico he abstained absolutely from having any connection with or interest in the management of any of our properties. Mr. Bruère advises us that he has made no recommendations regarding Mexican mining laws except as a member of the American Mining Committee and then only through action by that committee. Never at any time has he sought special consideration of Compañia de Minerales y Metales, or any other company, or in any other way used his connection with the Government for personal or company advantages.

4. We wish to point out to you also that the extension of our holdings in Mexico has been for the benefit of American interests, and not in any respect for the benefit of German interests. As stated above, 97.7% of the stock of the Minerales company is owned by the American Metal Co., Ltd. This company is, as you possibly know, controlled by British and American interests and its operations are conducted entirely by Americans. It is true that certain minority shares were owned long prior to the War by German stockholders, but these have been transferred to the Alien Property Custodian, who is now represented on our board of directors. It is a source of gratification to us that the foresight exercised by our board in resuming operations and expanding our activities in Mexico has put us in a position where we can now be of material assistance to our Government and its Allies by producing much needed supplies of lead, silver, and arsenic.

You will readily understand why our company takes exception to the manner in which your magazine has in

the past published these inaccurate and misleading articles, and as stated above, we take it for granted that they have been based upon misinformation. We have good reason to believe that much of this misinformation, particularly about our activities in Mexico, has been disseminated by unfriendly interests who are jealous of our success. So as to prevent your publication from being further misled, I want to assure you that we shall be glad to have you bring to our attention any similar reports which may be made to you, and we shall be ready at all times to give you the facts in reference to any transaction in which you are interested. It follows that as a matter of fair dealing, you will give this letter the same publicity that you have given to the articles themselves.

The American Metal Co., Ltd.,
By Otto Sussman,
New York, February 19. Vice-president.

The Editor:

Sir—Your editorial entitled 'Mexican Mining Law,' in the issue of February 9, contains many gross misstatements about the Compañia de Minerales y Metales, S. A. I take it that you aim to be exact in your editorial statements, even about those whom you dislike. Hence this letter.

I am an employee of the above-named company and have been since 1909, have had access to their files for several years past and have read them industriously, for several reasons, and I know whereof I speak. The Compañia de Minerales y Metales S. A. has *not* "been gathering up properties relinquished by other aliens in Mexico." All properties leased or bought have been taken over from pre-revolutionary owners, many of them aliens themselves, and not at a "pittance" as your editorial states, but at a valuation which is in accordance with the usual in like transactions. You cannot substantiate your statement with a single instance.

If the Cia. de Minerales y Metales, S. A., have taken over and are operating coal and metal mines, smelters, and railroads, it is because they have believed that revolutionary times in Mexico will not last always and they have had the financial courage to invest their money at a time when everyone else held off. Their acquisitions either through lease or purchase have been made through public documents following straightforward, honest, and above-board negotiations with those concerned and not in a manner implied by your word "wily." And if they have succeeded in operating their mines under present conditions it is because they had the foresight to buy railroad equipment when it could be bought and have used the industry, energy, patience, persistence, and courage required, and not because they have been favored. The superintendents of all their units are Americans, who, had they worked for any other company having the above-named qualifications and not afraid to invest their money would have accomplished the same.

The Mexican has no more respect or contempt for the American than he ever had. Any American who comes to this country with the necessary qualifications for operation in Spanish America, who behaves himself, and starts up his mines will find himself welcomed. Conditions have changed here; so have they in other countries. And whoever comes here and starts any industry is helping the people of Mexico at a time when they need help. And if you, Mr. Editor, also want to help Mexico you can do so much more effectively by doing some constructive thinking along the lines of Mexican mining law. Your editorials will be read and thought about more than you know. If Mr. Bruére has suggested that a change in policy is needed it is not because he is the representative of the American Metal Co., but because he is sincere in his work, and you can be sure that most all owners of mining property in Mexico, irrespective of their nationality, agree with him. If you will compare the amount of money needed to locate and hold a given area of ground under the present Mexican system and the American system you will see that in both cases it is beyond the means of the ordinary Mexican peon or vaquero, and you will find that the difference is against the American system.

Your statement that "meanwhile the mines are passing into the hands of the most exacting owner he could have selected, etc.," calls for comment. The personification of your word "exacting" in this case is honest, intensely human, progressive, and liberal. Ask any of their engineers who stay in Mexico under trying conditions when they could do as well financially in the States. The sense of loyalty between men still persists.

The source of your information is unreliable and untruthful. Run it down with an honest open mind and a scientific regard for facts and you will find that you have little to expose as regards the past and present actions of the Compañia de Minerales y Metales, S. A.

Frank J. Nagel.

Santa Eulalia, Mexico, February 23.

[We have not hesitated to give space to Dr. Sussman and to Mr. Nagel for their explanations, and courteous protests. The references made in our editorial columns to the subsidiary companies of the American Metal Co. operating in Mexico have been based upon information from correspondents whom we believe to be unbiased except by loyalty to the United States and the great cause to which our country is committed. The fact that the American Metal Co. owns 97.7% of the Mexican subsidiary is not as convincing as it might be, for the reason that the American Metal Co. has always been closely associated with the Metallgesellschaft, Henry R. Merton [true name Cohen] & Co., and other German firms, as ascertained by the Federal Trade Commission. See our issue of January 19, in which that part of the report of the Commission is given verbatim. We have known the principals of the American Metal Co. personally for many years and know them to be men of high character, but distinctly German, even when naturalized citizens of the United States or of Great Britain. Now it is a fact

that, by German law, the naturalization of a German in a foreign country does not involve a complete break with his mother country; on the contrary, the German government refuses to release its claim upon German citizens even after they have sworn allegiance to another country. Moreover, as Mr. Gerard has stated recently, "Germany does not recognize the American citizenship of a person born in Russia." Other governments, for instance, those of Great Britain and the United States, disown the citizen that surrenders his nationality by naturalization; Germany does not. For that reason we are justified in regarding the naturalization of a German as a legal process intended to give him sundry business advantages without corresponding obligations. If we remember correctly, the last German law on the subject was passed in July 1913. We have seen the text of it. This does not mean, and we do not imply, that Dr. Sussman and his friends are not loyal Americans, but it does mean that naturalization is not proof to the contrary. As to the Compañia de Minerales and its operations in Mexico, it is in high favor with Carranza, who is on cordial terms with our chief Enemy. The information on which we based the expression of our opinion was that of our correspondents after it had been confirmed by conversation with bankers and other responsible persons at El Paso. We concede frankly that the categorical denial of Messrs. Sussman and Nagel will have due weight, particularly with those that know them.—EDITOR.]

The War-Minerals Committee

The Editor:

Sir—The bill to control war-minerals, as outlined by Mr. Westervelt, chairman of the War Minerals Committee, should be vigorously supported by thinking and patriotic Americans, so that Congress will enact it without delay. In a republic there is always strenuous objection to anything that savors of government control. It might have been better, therefore, to have called this an efficiency bill for providing the necessary war minerals. It would seem as if the suspension of business on account of a shortage of coal were most opportune, as it teaches us how promptly and how forcibly we must act to prevent shortages in other industries. If our organization is so poor, or our facilities so bad, that an unusual stretch of inclement weather causes a complete breakdown, what would we do in the face of an enemy invasion, and what will become of our troops abroad in case of curtailment of our transport and supply service?

The United States is now at war with two nations that, through careful study and preparation together with efficient organization of their men and material for years, have occupied large parts of Europe outside of their domains. The three and a half years of effort of nations many times greater and richer in resources and materials have not forced these invaders to return to their own territory, or apparently to modify their plans of expansion. The European nations arrayed against Germany and Austria have not been able to suppress their enemies; they are wearing themselves out; their man power is reduced, and their resources impaired. It has become necessary for the United States to supply men, material, and food to carry the War to a decisive victory. The entrance of the United States into the War by the votes of the representatives of the people establishes the right of the Government to its men, materials, and supplies. It is now necessary to determine the most efficient organization for providing the materials and supplies for the military forces and for the protection of the people in their various walks of life. Administrators have already been appointed for food and coal supplies, and for the operation of the railroads; but there is no adequate organization to provide the Government with war-minerals. I have no doubt that Congress appreciates the necessity fully, and that it will hasten to pass the necessary laws creating an administrator or a director to control the war-minerals or to provide for procuring them as fast as they may be needed. The object of this letter is not to argue at length for the passage of a bill the expediency of which cannot be doubted, but to call attention to features which should be included in the bill to make it effective.

It must be borne in mind that at this time conditions are abnormal. Production and commerce are greatly demoralized and interrupted. Also that the war-mineral requirements of the country and of our Allies are vastly different from those in times of peace. Our first duty, then, is to provide for the taking of a complete census, (1) of the requirements of the country for its military forces and for the maintenance of its people, (2) of the requirements of our Allies, (3) of our existing resources, (4) of our potential resources, (5) of the markets of the world where deficiencies can be made up, and (6) of our mills, smelting, and other metallurgical plants, and their availability or adaptability for producing necessary materials and supplies.

To be of value, these facts must be collected and segregated by a corps of specialists, men of reputation as geologists, mineralogists, mining engineers, metallurgists, trained for the operation and management of operations under investigation. The work must be directed by an independent and unattached operator or engineer of wide experience. He must have full authority to demand complete reports from owners and producers, and to check them up by members of his staff sent to make examinations in person.

The second great need is the procuring of these necessary war-minerals. This must be done through a bureau or department in the organization of which the following must be borne in mind: (1) to work without conflict between the several governmental departments and to the best advantage of the different departments; (2) to prevent disastrous delays; (3) to compel just and reasonable prices, both to the producer and to the Government; (4) to prevent hoarding of materials to the detriment of the country or the advantage of its enemies, or for the purpose of gaining unfair profits; (5) to send commissions to foreign countries to procure necessary supplies,

which cannot be procured at home, and to prevent our enemies from procuring said supplies for their own use or to our detriment by depriving us of them; (6) with authority in cases of necessity, such as the unwillingness of the owners of plants to meet the fair demands of the Government, to operate mines, mills, smelting, or other metallurgical plants, whenever necessary, and when it is apparent that, under other conditions or in other ways, the requirements of the country cannot be met; (7) with authority to build mills, smelters, or other metallurgical plants whenever necessary and when it is apparent that the owners cannot or will not do same upon the Government's recommendation, and when necessary to meet the requirements of the Government; (8) to contract for necessary supplies in the quantity, and at the prices, that will justify or protect patriotic citizens to undertake new business, thus relieving the Government of a portion of its burden; (9) to buy material and supplies, and to distribute the same to the manufacturers in the way that will assure to the Government its finished articles when needed; (10) to requisition materials and supplies on sight when necessary, when it is found that the owners refuse to treat with the Government, or to accept reasonable offers of the Government for purchase; (11) to organize a corps of trained specialists for the inspection of mines, mills, or metallurgical plants, to advise and assist in the operation of these plants, to determine whether the work at these plants is carried on efficiently and without waste, and to provide the information necessary for the chief of the bureau to enforce modification of plants when it has been demonstrated that there is inefficiency and waste; (12) to organize a trained staff whose business shall be to become fully informed as to the requirements and plans of the administrator, and to check up and see that his orders are being promptly carried out. This staff should further check up independently, but under the direction of the administrator, the orders as given out so that no details may be omitted, and that the orders can be executed according to schedule.

There is no desire, I believe, on the part of the Government, to usurp the rights of the people, but there is a great necessity to provide an organization which will furnish people with the necessaries of life, and its fighting forces with the weapons with which to fight successfully that the War be brought to a just termination. Our two Allies, who have been able to check the advances of the Enemy, adopted a system fully as drastic as the one here proposed. They have found it necessary to send representatives to all parts of the world with authority and with money to secure the necessary materials for their armies in the field, and for the maintenance and existence of the people at home, and they are trading in the supplies which they have acquired in foreign countries not only with other foreign countries, but with their own Allies.

I have just returned from a two years' trip through Portugal and Spain, and have come into personal contact with the methods adopted by some of the countries at war in their efforts to obtain supplies. My operations, and those of my American associates, were seriously handicapped through the activites and the zeal of at least two of the government agents of the Allies of the United States, for which in all probability, sooner or later, an accounting will be made, but at the time these activities were fully supported by their home governments.

The market conditions in the United States concerning certain war-minerals are most unsatisfactory. Fluctuations of price, due in part to manipulation, have been discouraging, and have caused the shut-down of many properties which should now be operating to their maximum capacity. Methods now in vogue for determining values, and the arbitrary methods adopted by many purchasing companies, have added to the confusion, increased dissatisfaction, and further curtailed production. Even litigation has been employed as a means to curtail production. Whether this be inspired by the Enemy, or results from the uncontrolled state of business, matters not; the fact is, that our fighting forces are held back, the War is protracted, the Enemy is encouraged, and the loss of life and property thereby is incalculably increased.

GEORGE WARREN TOWER JR.

New Rochelle, N. Y., January 19.

Sea-Water for Flotation

The Editor:

Sir—Some time ago I investigated the effect of seaweed on the rate of corrosion of condenser-tubes by seawater. The solution, in which the test-pieces were immersed, was not changed and I noted that after a few days it became rather oily in character and could easily be made to foam. I would suggest to the correspondent whose interesting contribution you published in your issue of February 2, that he try such a solution as a frothing-agent in his tests.

PAUL T. BRUHL.

Aurora, Nevada, February 7.

LYCOPODIUM is a vegetable material which, before the War, was used for dusting or coating the molds in foundry practice, in order to prevent the sand from clinging to the castings. Lycopodium came exclusively from Russia and there is none available now. Experiments have showed that by a centrifugal process the dust, which is precipitated from the gas exhalations of the drying apparatus in the works where coal or lignite is briquetted, can be used successfully to replace lycopodium. The light particles of dust, which contain a large percentage of paraffin, have the same properties as lycopodium, as may be seen when water is poured upon them.

ELECTRIFICATION of mine hoists in 1917 did not continue at the rapid pace set during 1916, yet over 22,000 hp. was installed.

The 2000-Ton Leaching Plant at Anaconda

By FREDERICK LAIST and H. J. MAGUIRE

The equipment and operation of the 2000-ton copper-leaching plant at Anaconda has been previously described by Laist and Aldrich. It is not intended to duplicate the information contained in the above paper except in so far as it may be required to give a comprehensive view of the methods employed. The plant has now been in operation about two and a half years, treating the accumulated concentrator sand-tailing from the dump. By November last 1,432,617 tons of the 20,000,000 tons of tailing, estimated to have been in the dump, had been treated.

This copper-leaching process makes a very high recovery when treating a de-slimed uniformly sized sand. These conditions, however, are so hard to obtain that it can scarcely be expected that the leaching process will compete with flotation on a freshly mined ore, but, with the class of material, partly oxidized as it is, which this plant is treating, it is hardly possible for the flotation process to compete successfully. The wide demand for sulphuric acid has made it exceedingly difficult for the leaching plant to obtain anywhere near the quantity required. The idea, under these circumstances, has been to try to produce the greatest quantity of copper with what acid might be available, rather than to reduce the capacity for the purpose of a better recovery.

The equipment consists of the following:

- 6 sand-storage bins, capacity 6000 tons.
- 28 20-ft. diam., 6-hearth McDougall furnaces, capacity 100 tons per furnace.
- 28 coolers, one for each furnace.
- 16 cement-lined steel mixers.
- 10 lead-lined redwood tanks, 50 ft. diam. by 14-ft. stave, capacity 1000 tons of calcine each.
- 5 unlined redwood tanks for solution-storage, 50 ft. diam. by 14-ft. stave.
- 12 concrete precipitating-launders 5 ft. deep by 10 ft. wide, with a total capacity of 35,300 cubic feet.
- 7 4-in. hard-lead centrifugal pumps, capacity 60 tons of solution per hour.
- Belt-conveyors for carrying the sand-tailing to the furnaces and the calcine from the furnaces to the leaching-building.

PRODUCT FED. An average screen analysis of the sand-tailing dump is given below:

Mesh	Opening mm.	Cumulative %
20	0.926	22.6
40	0.429	64.7
60	0.260	82.0
80	0.207	89.1
100	0.149	93.8
160	0.0856	97.7
200	0.0763	98.5
−200	....	1.5

The average metallic content is about 0.65% copper, and 0.50 oz. silver per ton.

The screen analysis of the sand-tailing treated during July last is:

Mesh	Opening mm.	Cumulative %
14	1.18	4.26
20	0.833	15.58
28	0.589	32.44
35x	0.417	51.92
48	0.295	66.05
65	0.208	77.50
100	0.147	87.29
150	0.105	93.52
−150	....	6.48

The following shows the analyses of the sand-tailing for the first half of 1917, and also for July and August:

	H_2O %	Cu %	Ag oz.	SiO_2 %	FeO %	S %	Al_2O_3 %	CaO %
July	4.49	0.72	0.54	81.5	3.3	2.7	7.9	0.3
August	4.74	0.72	0.51	81.6	3.2	2.9	8.1	0.4
Half-year	6.53	0.77	0.59	81.0	3.4	2.9	8.3	0.2

The details of operation in regard to roasting are identical with those given in a previous paper. To assist the furnace-man in the control of roasting, a pyrometer is inserted in the fourth hearth of each furnace, and the recording instrument, one for each set of four furnaces, is set up at a convenient place on the firing floor. The temperature which gives the best results is about 950°F. The temperature of the third, or fired hearth, is about 1050°F. The range of temperature never varies more than 30°F. either way from the temperature desired. When a furnace-man has become accustomed to this kind of work and has a reasonably good grade of coal, he can hold the temperature at the desired point for eight hours with no difficulty. One furnace-man fires four furnaces with two fire-boxes to a furnace. The calcine after roasting is cooled to a temperature of about 125°F., and a little water is added to it in the mixers to lay the dust before discharging to the conveyor-belt on its way to the leaching-tanks. A sample of the roaster work is here given. The time-period is taken at random from the records for 1917:

	Feed		Calcine	
July	H_2O %	S %	Total Sulphur	Sulphur as sulphate
8	4.00	2.65	0.55	0.26
9	5.00	2.63	0.54	0.24
10	5.00	2.77	0.54	0.26
11	4.50	2.76	0.54	0.26
12	4.75	2.71	0.53	0.27
13	4.50	2.80	0.55	0.25
14	5.00	2.47	0.55	0.25
15	5.00	2.62	0.52	0.26
16	5.00	2.76	0.50	0.25
17	5.00	2.57	0.55	0.26
Average	4.78	2.67	0.54	0.26

It will be noticed that the sulphur in the calcine in sulphate form is almost half that of the total sulphur. The quantity of water-soluble copper is almost identical with that of the sulphate-sulphur produced.

A screen analysis of calcine from the leaching-plant treated in July is as follows:

		Calcine	
Mesh	Opening mm.	Solids %	Solids cum. %
14	1.18	4.58	4.58
20	0.833	12.09	16.67
28	0.589	17.96	34.63
35x	0.417	19.48	54.11
48	0.295	13.92	68.03
65	0.208	10.92	78.95
100	0.147	9.14	88.09
150	0.105	5.78	93.87
−150	....	6.13	100.0

Leaching. The solutions are pumped to the top of the charge, thus making all percolation downward. The rate of percolation varies with the different solutions. The first, or No. 1, solution will percolate at a rate of about three inches per hour, while the rate for the hot wash-water is from 10 to 12 in. per hour. The slow rate of the No. 1 solution is partly due to its being more viscous than the succeeding solutions, and partly to its being the pioneer solution. To thoroughly saturate a charge of calcine requires about 25% of its weight of solution. This will fill the space under the cocoa-matting and the false bottom, and will also cover the top of the calcine completely.

There are five stock-solution storage-tanks.

	Cu %	H_2SO_4 %	NaCl %
No. 1 solution-tank	0.9	5.0	9.5
No. 2 solution-tank	0.3	2.0	6.5
Copper-solution tank	1.9	1.5	8.0
No. 1 wash-solution tank	..	1.0	6.0
Wash-water drainage-tank	0.2	1.0	6.0

When a tank has been filled with calcine the drain is closed and the No. 1 solution is pumped on until the charge is thoroughly saturated. It is customary to spread about two or three tons of salt on the charge just ahead of this solution. After saturation has taken place the drain-valve is opened and drainage to the copper-solution storage-tank begins. Fifty tons of No. 2 stock-solution is then pumped on, thus keeping a head of solution on top of the charge. When the drainage has progressed to the point where the solution just disappears under the calcine the drain-valve is closed and 10 tons of salt is spread over the charge. On top of this salt is added the strong-acid solution. This is made up on the charge by adding 60°B. sulphuric acid to 90 tons of the No. 2 stock-solution and this is brought to 27% H_2SO_4. This is the only point in the operation where acid is added to the solutions. When sufficient acid is not available for this, it is here that the reduction is made. Fair results can be obtained with 65 tons of solution at 15% H_2SO_4. The strong-acid solution is followed with 110 tons of No. 2 solution. The drain-valve is opened as soon as the top of the calcine has been covered with this strong acid. As soon as this strong acid shows in the drainage the drain-valve is closed and aeration takes place. The air is applied underneath the false bottom, 16-lb. air being used. Some care is required in the application of the air. It is essential for good aeration that little or no solution should be underneath the cocoa-matting when the air is applied. The application of the air takes place intermittently from this point until the end of the leach. The washing of the charge is done with 300 tons of No. 1 wash-solution, followed by 300 tons of fresh hot water from the calcine-coolers.

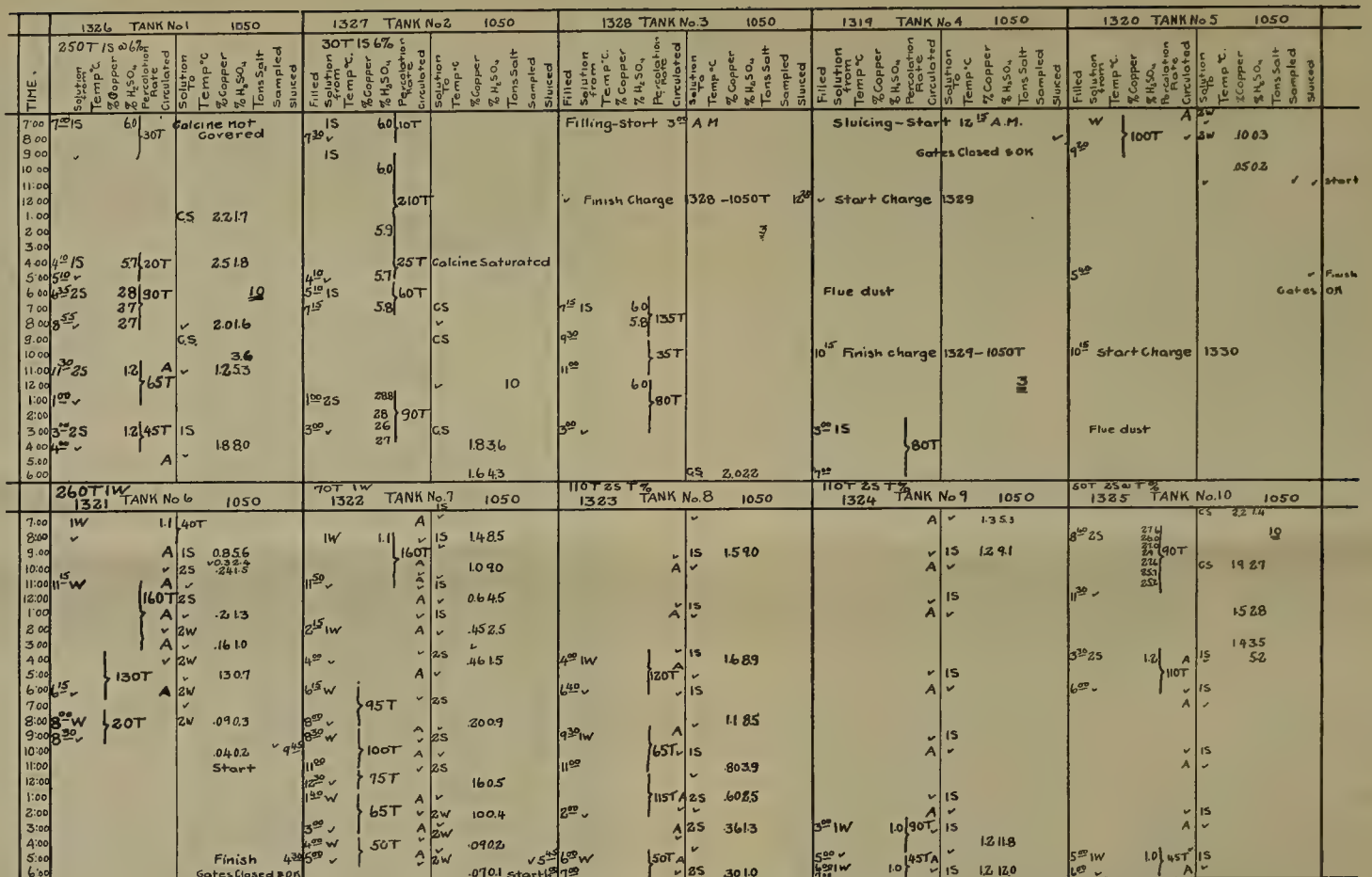
The object of introducing the 50 tons of No. 2 solution before the strong-acid solution is put on, is to have it act as a piston protecting the copper-solution from this strong-acid solution. The idea is to get the bulk of the copper into the copper-solution, and to protect the copper-solution, which must go through iron for precipitating the copper, from getting strong acid mixed with it.

The 250 tons of No. 1 solution added becomes the strong-copper solution, whic is as nearly acid-free as can be made. This is drained to the copper-solution storage-tank, from where it is drained to the precipitation launders. All of the No. 2 solution (50 + 90 + 110 tons) drains to the No. 1 solution-storage tank and becomes available as No. 1 solution for the next leach. The first 100 tons of the No. 1 wash-solution is drained to the No. 2 solution tank to make up for the solution discarded daily. The remaining 200 tons is drained to the wash-water drainage-tank. About 100 tons of the fresh water added finds its way into the system through the wash-water tank. What is available from the remaining 200 tons is drained directly to a separate precipitation launder, where this solution is discarded. The main idea in the disposal of solution is the conservation of NaCl, or its equivalent in chlorine, for further use.

Water is used to sluice out the tailing after leaching. A charge can be sluiced if necessary in about 6 hours, that is, from the time the first door is opened until the seventh door is closed and the tank is ready for calcine. The usual time, however, is about 8 hours. A screen analysis of tailing from the leaching-plant for July is here given:

		Tailing	
Mesh	Opening mm.	Solids %	Solids cum. %
14	1.18	4.51	4.51
20	0.833	12.98	17.49
28	0.589	18.99	36.48
35x	0.417	20.55	57.03
48	0.295	13.76	70.79
65	0.208	10.55	81.34
100	0.147	8.71	90.05
150	0.105	5.05	95.10
−150	....	4.90	100.0

A tabulation of the results which led to cutting down the volume of strong acid used and increasing the percentage of H_2SO_4 is also presented. On June 6, 1917, it was decided to try 138 tons of 20% H_2SO_4 in the odd-number tanks and 120 tons of 23% H_2SO_4 in the even-number tanks for one cycle.



MEN	1st Shift	2nd Shift	3rd Shift
Solution	Baker	Moe	Earle
Sluicers	2	2	2
Helpers	4	4	4

	No 1 Sol. Cu	No 1 Sol. H_2SO_4	No 1 Sol. NaCl	No 2 Sol. Cu	No 2 Sol. H_2SO_4	No 2 Sol. NaCl
10:00 A.M	1.0	6.0	9.5	.26	1.4	5.3
6:00 P.M.	1.1	5.7	9.6	.30	1.2	5.4
2:00 A.M.	1.2	6.0	9.5	.30	1.2	5.5

Time	Tank	Cu.	H_2SO_4	NaCl
7:00	1W	016	1.1	4.4
4:00	"	.01	0.8	4.4
12:00	"	02	1.0	4.4

Acid Tank	Time	Cu Sol.	C.S.O. Flow	W.W. In	W.W. Out	Drain
Time Depth	AM	Cu Acid	Cu Acid	Cu Acid	Cu Acid	Cu Acid
8	8	1.9	8.0	.005	1.5	.06
2.00	5.8	12				0.5
4	4	1.9	1.7	Nil	0.8	.10
10.30	5.4	8		1.2		0.5
12	12	1.8	2.1	1.5	1.2	0.4
5.30	8			1.8	2.0	0.3
AM	10					
	4.00 AM					

Cu Sol. O'Flow { Return 7.00 A.M to 8.45 P.M. / Discard 8:45 P.M. to 3:45 A.M. / Return 2.45 A.M to 7.00 A.M

W. W O'Flow { Return 7 A.M to 7 A.M.

ODD-NUMBER TANKS

138 tons at 20% H_2SO_4

Charge No.	Tank	Copper in calcine, %	Copper in tailing, %
1203	7	0.72	0.146
1205	9	0.72	0.128
1207	1	0.74	0.148
1209	3	0.72	0.168
1211	5	0.69	0.156
Average	..	0.716	0.149

EVEN-NUMBER TANKS

120 tons at 23% H_2SO_4

Charge No.	Tank	Copper in calcine, %	Copper in tailing, %
1204	8	0.72	0.138
1206	10	0.71	0.101
1208	2	0.69	0.101
1210	4	0.75	0.133
1212	6	0.75	0.149
Average	..	0.725	0.124

On June 11, 1917, it was decided to try 90 tons of acid at 25% H_2SO_4.

Charge No.	Tank	Copper in calcine, %	Copper in tailing, %
1215	9	0.78	0.134
1216	10	0.77	0.151
1217	1	0.75	0.120
1218	2	0.68	0.127
1219	3	0.73	0.132
1220	4	0.71	0.139
1221	5	0.77	0.097
1222	6	0.74	0.110
1223	7	0.71	0.090
1224	8	0.67	0.116
1225	9	0.70	0.131
1226	10	0.67	0.094
1227	1	0.70	0.128
1228	2	0.74	0.151
1229	3	0.74	0.114
1230	4	0.75	0.104
1231	5	0.77	0.121
1232	6	0.75	0.109
1233	7	0.77	0.088
1234	8	0.80	0.084
1235	9	0.76	0.071
1236	10	0.77	0.103

On June 20 it was decided to increase the acid by 2% H_2SO_4, that is, 90 tons at 27% H_2SO_4. The results have justified the increase of strength in the acid used. If a smaller volume of solution could be used with any degree of certainty that it would reach all portions of the charge, about 75 tons at 27% H_2SO_4 would be sufficient. Considerable care in draining the solution is required to avoid channeling, thus preventing all the charge getting its share of this strong acid and salt solution.

PRECIPITATING. The copper-solution and wash-water drainage flow through concrete launders filled with iron for the precipitation of the copper. These solutions may be kept separate or be run together during their journey through the launders. About one-fourth of the copper-solution overflow is discarded, the other three-fourths being returned to the No. 2 solution tank. All the wash-water overflow from the launders is returned to the system. On leaving the iron launders the solutions are mixed and returned through the same pump. When the returning solutions are entirely free from copper they are sent to the No. 1 wash-solution tank, and when a little copper is contained in the solution it is returned to the No. 2 solution tank. There is a total precipitating capacity of approximately 35,300 cu. ft., making roughly one and a half cubic feet per pound of copper precipitated daily. It requires only about 0.9 cu. ft. capacity to precipitate one pound of copper per 24 hours from a solution carrying 1.9 to 2.0% copper, while it requires over 3 cu. ft. for the wash-water running 0.25 to 0.30% copper to precipitate one pound of copper in the same time. The quantity of iron in one cubic foot of space is about 110 lb., that is, it averages this for the entire system.

The copper-solution contains $CuSO_4$ and $CuCl_2$. The bulk of the copper is in the form of chloride. This probably accounts for the rapidity with which precipitation takes place, and also for the spongy nature of the cement copper. With ordinary care in cleaning the precipitating launders regularly the precipitation of the copper is absolute. Each launder is washed out once every four days with water. No copper whatever sticks to the iron, and the only reason it is ever necessary to remove the iron from the launder is to take out the accumulated copper and small pieces of iron from underneath the wooden racks. This is done at least once every two months on the first two launders that receive copper-solution. The iron is removed from the other 10 launders not more than once a year. The cement copper averages 65 to 70% copper and about 50 oz. silver per ton. The quantity of iron consumed per pound of copper produced is 1.05 lb. This figure is obtained from the actual weight of the iron used against the weight of copper produced over a period of 28 months. The figure obtained by determination of the iron in the copper-solution to the launders, and the iron in the copper-solution overflow from the launders, is 1.02 lb. of iron for each pound of copper precipitated.

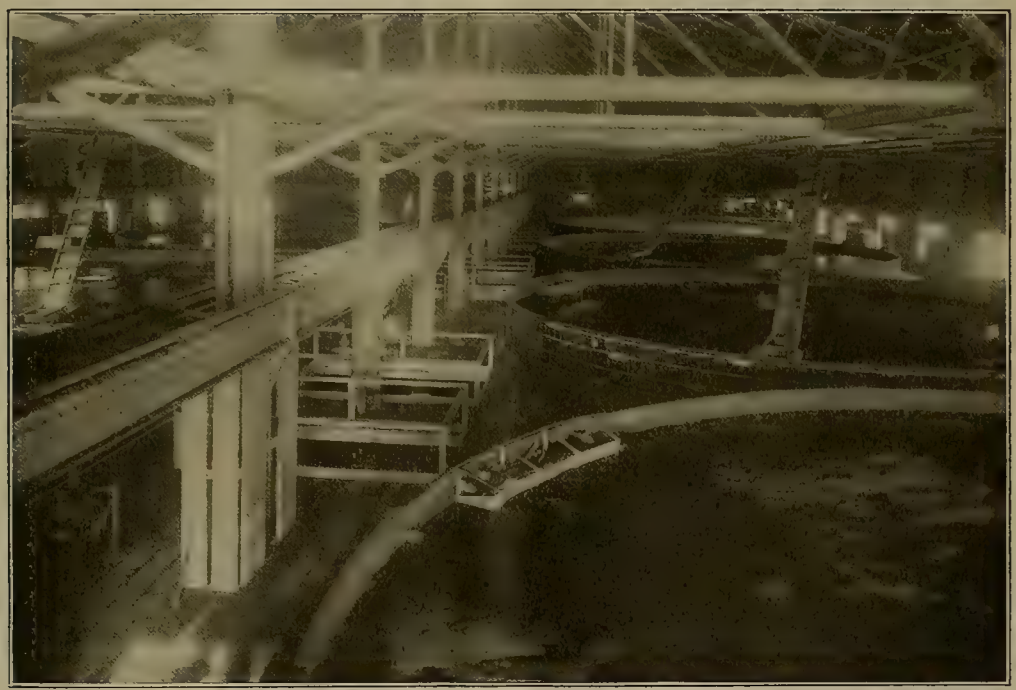
RESULTS. The performance of the leaching-plant is given, as taken from the monthly metallurgical report for July 1917. The results for August show a higher recovery, but it is hardly representative, owing to the 'walk-out' on August 23, making it a short month.

Sand-tailing treated, tons	67,076.9
Copper in feed, per cent	0.72
Silver in feed, ounces per ton	0.54
Copper in tailing, per cent	0.13
Silver in tailing, ounces per ton	0.19
Sulphuric acid, pounds per ton (100% acid)	50.79
Coal, per cent of feed	3.69
Salt, per cent of feed	1.23
Pounds of copper in feed	970,503
Pounds of copper recovered	720,801

The actual recovery of copper is 74.27%, while the theoretical, based on assays of heading and tailing, is 81.94%. This discrepancy is due partly to stack-loss and partly to the tailing obtained by the pipe sampler being higher in copper than indicated. The use of dirty water for sluicing allows only this one way for sampling. The



HORIZONTAL CONVEYOR AND AUTOMATIC TRIPPER FOR DISTRIBUTING ORE



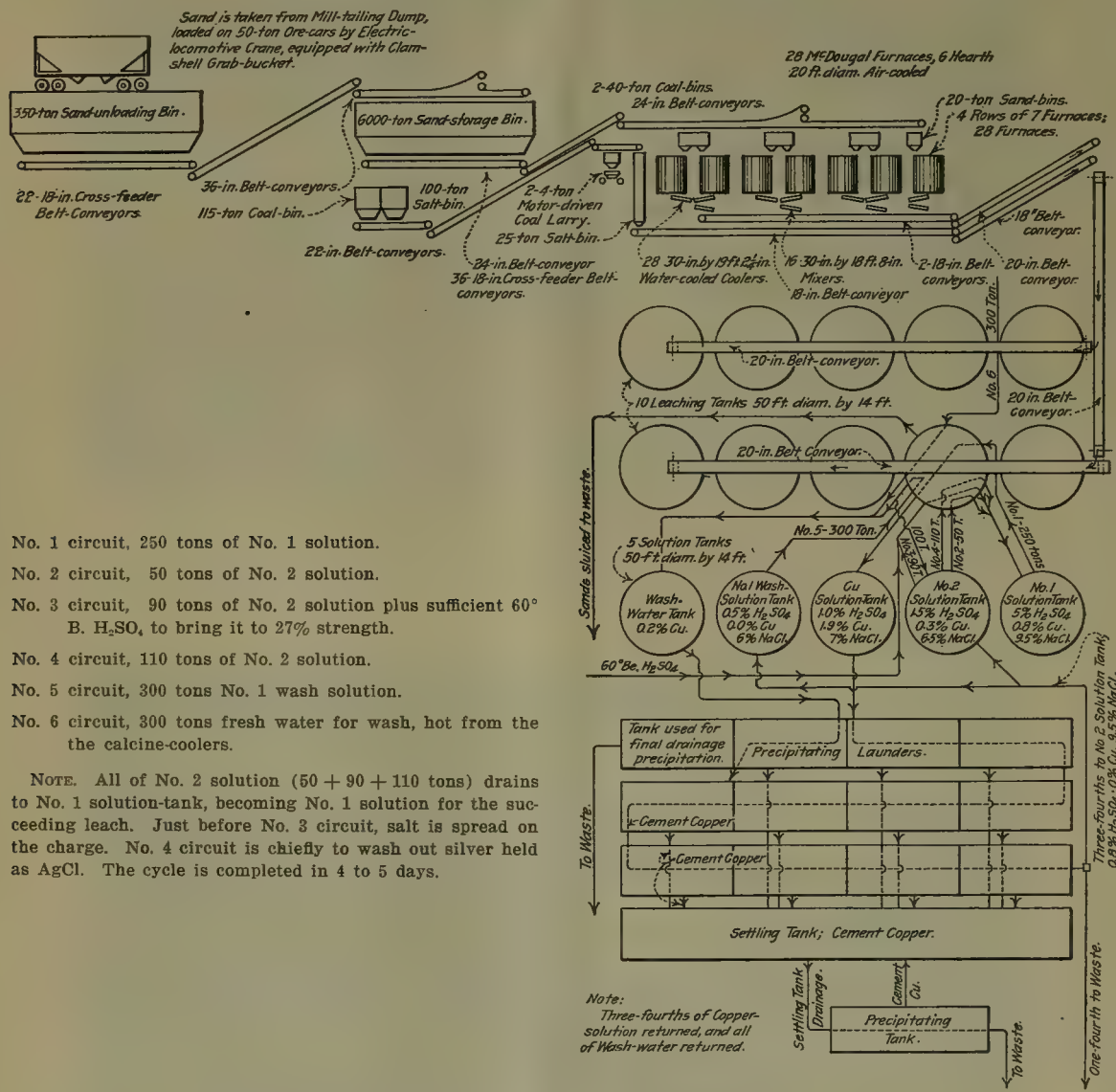
LEACHING VATS, ANACONDA COPPER MINING COMPANY

high coal-ratio is due to a poor grade of coal, and should be not over 3.3%.

The material that lends itself most readily to roasting and leaching falls between the sizes of 14 and 150 mesh, that is, the sizes through 14 mesh and on 150 mesh give the best recovery of copper. Some idea as to the fineness of the dust which escapes through the stack may be gained from a screen analysis of the dust that is recovered before entering the stack.

Mesh	65	80	100	150	200	300	−300
Cum. %	1.65	4.15	6.35	12.70	17.20	22.20	77.80

The amount of $Fe_2O_3 + Al_2O_3$ dissolved per ton of calcine leached is about 25 to 30 lb. The ratio of Fe_2O_3 to Al_2O_3 dissolved is about 1.5. The concentration at which to begin discarding solutions is when the returning solution shows about 0.09 gm. per cubic centimetre of $Fe_2O_3 + Al_2O_3$. Solution-tonnages are determined by rating the pumps or by measurements on the top of the charge. No attention is given to the tonnages of draining solutions; their disposal depends on the analyses.



FLOW-SHEET OF ANACONDA 2000-TON COPPER-LEACHING PLANT

No. 1 circuit, 250 tons of No. 1 solution.

No. 2 circuit, 50 tons of No. 2 solution.

No. 3 circuit, 90 tons of No. 2 solution plus sufficient 60° B. H_2SO_4 to bring it to 27% strength.

No. 4 circuit, 110 tons of No. 2 solution.

No. 5 circuit, 300 tons No. 1 wash solution.

No. 6 circuit, 300 tons fresh water for wash, hot from the the calcine-coolers.

NOTE. All of No. 2 solution (50 + 90 + 110 tons) drains to No. 1 solution-tank, becoming No. 1 solution for the succeeding leach. Just before No. 3 circuit, salt is spread on the charge. No. 4 circuit is chiefly to wash out silver held as AgCl. The cycle is completed in 4 to 5 days.

NITRIC ACID is being consumed by the Government at the rate of 200,000 tons per annum, mostly in the manufacture of explosives. If made by the arc-process this would entail the utilization of 600,000 hp., or 50,000 hp. more than the total Niagara power development. In Norway the arc-process is extensively used, but the power-costs are under $6 per hp. year. The cyanamide process for fixing nitrogen requires approximately ½ hp. year per ton of nitric acid against 3 hp. year per ton by the arc-process.



NORTH WALL OF THE WEST ARM OF THE NORTH BLOOMFIELD MINE

Hydraulic-Mining Debris in the Sierra Nevada

By G. K. GILBERT

*Hydraulic mining in the Sierra Nevada commenced in the early 'fifties and continued in the face of opposition from the residents of the Sacramento and San Joaquin valleys until 1884. A series of injunctions was obtained in that year, which, although it did not eliminate hydraulic mining, restricted it to such an extent that little has been done since. Some of the hydraulic mines discharged tailing directly into streams, others upon gentle slopes of the land. After checking mining operations the deposits in the mountain streams were gradually washed down-stream. Where the rivers left the mountain gorges and entered the great valley there was an abrupt reduction in slope and velocity, resulting in the deposition of debris. These deposits, which may be called Piedmont deposits, extended toward the valley from the foot of the range, and usually reached the mid-valley trunk-stream. The material was coarse near the mountains and finer farther west. At the same time, deposits were being made in the main trunk-streams of the valley, namely, the Sacramento and Feather rivers.

The quantity of debris that a given stream transports is its load; the quantity it can transport may be called its capacity. Capacity varies with slope. The greater the slope the greater is the capacity. The change in capacity is always larger than the change in slope. Capacity varies with discharge. When the discharge is increased, the capacity per unit of discharge is also increased. An increase in discharge, however, does not increase capacity so much as the same relative increase in slope. Capacity varies with the character of the debris transported. The lower the specific gravity of the debris the greater the capacity, that is, the greater the weight of load which may be transported. The finer the debris the greater the capacity. Capacity is affected also by the shapes of the particles of debris, but, in general, only the size-factor is considered in relation to capacity. Size may be measured by diameter or by volume. In whichever way it is measured, an increase in fineness causes a somewhat greater increase in capacity. Capacity varies with the ratio of depth of water to width of stream. In the main, capacity increases with increase of this ratio, and this is true of the streams of Sacramento valley, but the opposite rule applies to small values of the ratio.

The fact that there is a limiting condition below which transportation does not take place is expressed by the word competent. For a stream of given discharge, flowing in a given channel and carrying debris of a given fineness, there is a competent slope; in a channel of given form and slope, and with debris of given fineness, there

*Abstract: Professional Paper No. 105, U. S. Geological Survey.

is a competent discharge; and for a given discharge in a given channel there is a competent fineness. The ratio in which capacity is modified by a change in slope, discharge, fineness of debris, or depth of current, is greater when the conditions are near competence than when they are far above competence. In other words, capacity is most sensitive, when near its lower limits, to changes in the conditions that control it.

The laws have been experimentally determined for the bed-load† treated by itself, and they are believed to be approximately true for the suspended load by itself. Nevertheless they cannot be affirmed for the total load, because of complications caused by the shifting of material from one load to the other. If a stream that is loaded to its full capacity reaches a point where the slope becomes smaller, it becomes overloaded. Part of the load is dropped, making a deposit. If a fully loaded stream reaches a point where the slope becomes steeper, its enlarged capacity causes it to take more load, and the taking of load erodes the bed. If the slope of the stream is not adjusted to the discharge and to the load it has to carry, then the stream continues to erode or deposit, or both, until adjustment has been effected and the slope has become just adequate for the work. Any change of conditions which destroys the adjustment between slope, discharge, fineness, and load, makes re-adjustment necessary and starts a series of changes which may extend to all parts of the stream-profile. The mining debris disturbs the adjustment of the streams by adding to their load. Reclamation by levees disturbs it by increasing the flood-discharge in parts of the river-channels.

The law of adjusted profiles applies to streams with mobile beds, that is, alluvial streams. Streams with fixed beds are normally under-loaded, and their beds are modified only by abrasion. This process works toward an adjustment of slopes, but very slowly, and the factors involved are different from those of alluvial streams. The channel of an alluvial stream is composed of alternating ponds and shoals. The dimensions of these are related to the discharge. The variable discharge modifies these continually, each particular discharge tending to adjust them to its needs. Because of the greater power of streams during flood, the pattern of the bed is most nearly adjusted to flood-conditions. An alluvial stream that is not confined by rigid banks shapes for itself a course made of curves. The curves are not stationary, but undergo continual changes. The curve-pattern is large for a large stream and small for a small one. In a variable stream the pattern is adjusted to the needs of the flood-discharge. The general slope of a stream-bed is determined chiefly by the load that travels at the time of the larger floods.

The laws thus far stated apply to the transportation of debris along a bed composed of similar debris. When a stream is made to sweep debris along the unyielding bed of a sluice or flume other laws apply. Capacity is greater for smooth beds than for rough. It is greater for coarse debris (up to the limit of competence) than for fine. In general it is greater for a flume than for a natural stream of the same size.

The amount of debris that has been removed since hydraulic mining practically ceased is indicated by the following: At the 'Narrows' of the Yuba river, several miles above Marysville, is a gauging-station of the U. S. Geological Survey. In 1903 a discharge of 500 second-feet corresponded to a gauge-reading of 13.6 ft. In 1913 the gauge-reading for the same discharge was 4 ft. At Sacramento, the records show low-water readings of zero in the city gauge in 1849 and 1856. In the early 'nineties, the low-water readings averaged about 10 ft., while in 1913 the low-water reading was 3 ft. In 1849 the tidal range at Sacramento was about 3 ft. This disappeared entirely about 1880, but re-appeared when the river again began to scour. In 1913 the tidal range was 1.5 ft. Estimates have been made of the amount of debris deposited in Suisun, San Pablo, and San Francisco bays, and in Carquinez strait, based on soundings by the U. S. Coast and Geodetic Survey. In Suisun bay, 64,000,000 cu. yd. was deposited between 1867 and 1886; in Carquinez strait, 40,000,000 cu. yd. between 1861 and 1890; in San Pablo bay, 366,000,000 cu. yd. between 1857 and 1897; and in San Francisco bay, 196,000,000 cu. yd. was deposited between 1856 and 1896. The total estimated amounts for the period 1849-1914 are as follows: Suisun bay, 200,000,000 cu. yd.; Carquinez strait, 50,000,000 cu. yd.; San Pablo bay, 570,000,000 cu. yd.; San Francisco bay, 326,000,000 cu. yd, making a total of 1,146,000,000 cu. yd. Approximate surveys were also made in 1909 to determine the amount of material removed in mining between 1849 and that year. These amounts are given below. The quantity removed since that time is comparatively small, probably between 5,000,000 and 10,000,000 cubic yards.

Hydraulic mining:	Cubic yards
Upper Feather river	100,000,000
Yuba river	684,000,000
Bear river	254,000,000
American river	257,000,000
Streams tributary to lateral basins of Sacramento river	30,000,000
Mokelumne to Tuolumne river, inclusive	230,000,000
Placer mining	60,000,000
Quartz mining (one-fourth in Sacramento basin)	50,000,000
Drift-mining (three-fourths in Sacramento basin)	30,000,000
Total mining debris:	
From hydraulic mining	1,555,000,000
From all mining tributary to Sacramento river	1,390,000,000
From all mining tributary to Suisun bay	1,665,000,000

The last-named amount is nearly eight times the material moved in constructing the Panama Canal.

In addition to mining, other causes have contributed to the erosion. Cultivation can be practised so as to reduce erosion instead of increasing it, but such methods are not usual in the Sierra Nevada. Roads and trails on steep grades and the side-ditches dug to protect roads,

†U. S. Geological Survey Professional Paper 86, 1914.

all assist erosion. So also does over-grazing. In addition there is considerable 'natural' erosion. The total 'non-mining' debris removed from the land surface of the various water-sheds tributary to Suisun bay between 1849 and 1914 is estimated at 700,000,000 cu yd., of which 420,000,000 is from the watershed of the Sacramento river. If the mining debris is added, allowance being made for what has been removed since 1909, the total for the watersheds tributary to Suisun bay is 2,375,000,000 cu. yd., of which 1,820,000,000 cu. yd. is credited to the Sacramento river watershed.



PIEDMONT DEPOSIT OF THE YUBA SHOWING DEBRIS PLAIN NEAR ITS BROADEST PART

Surveys indicate that at the present time this amount is distributed approximately as follows:

	Cubic yards
Deposited within the mountains	265,000,000
Piedmont deposits	520,000,000
Deposits in the channels of valley rivers	100,000,000
Deposits on inundated lands, including tidal marshes	294,000,000
Deposits in the bays	1,146,000,000
Deposits in the ocean	50,000,000
Total	2,375,000,000

This estimate of the mining debris does not include the material that is being and will continue to be washed by natural agencies from the slopes of abandoned hydraulic-mine workings.

Future movement and re-adjustment of the deposits of debris will be affected by restraining-works on rivers such as have already been built on the Yuba river at Daguerre point, but more especially by the work for flood-control now being done on the valley streams. In a few years a system of by-passes and levees will be completed, cutting off the basins that used to receive a large proportion of the debris carried by the rivers. These flood-control works will hasten the scouring of the main river-channels that is now in progress, and the debris now in the river-channels will be deposited in the bays. Of the 625,000,000 cu. yd. of mountain deposits of debris, 100,000,000 cu. yd. will probably remain in the mountains. Of the 520,000,000 cu. yd. of Piedmont deposits, 335,000,000 cu. yd. will probably be permanent. This leaves 350,000,000 cu. yd. to be carried to the bays. Assuming 50 years as the time when the amount of mining debris moved will have become negligible, and that 8,000,000 cu. yd. per year is the annual loss from erosion from natural causes, then the non-mining debris to be carried by the rivers in that time will be 400,000,000 cu. yd. Adding the amount now in the rivers, and the 350,000,000 cu. yd. of mountain and Piedmont deposits, gives 850,000,000 cu. yd. Two-thirds of the mountain and Piedmont deposits is coarser than silt, and the river deposits are almost entirely sand. Seven-eighths of the soil-waste is silt. However, in being carried to the bays, nearly all the material will be so comminuted before it comes to rest that it will be exceedingly fine. Of the total amount, it is estimated that 50,000,000 cu. yd. will be deposited on the inundated lands before the reclamation projects now under way are completed, 40,000,000 cu. yd. will be carried to the ocean, and the remaining 760,000,000 cu. yd. will be deposited on the various shoals in the bays. In other words, the amount of debris now deposited on the shoals will be increased about 67%. A continuous channel exists from the mouths of the Sacramento and San Joaquin rivers to the Golden Gate bar. This channel is maintained by tidal currents. The tides are such that the stronger ebb-currents have a higher velocity than the stronger flood-currents. The ebb-currents, moreover, are reinforced by the discharge from

the rivers. Consequently, sand and other coarse debris delivered to Suisun bay by the rivers, and dragged forward and backward by the currents, has a net movement toward the bar. While thus in transit it suffers attrition, and the greater part is ground so fine as to leave the channel-bed and to pass into suspension. At Pinole shoal, in San Pablo bay, midway between the river mouths and the bar, the coarsest material in the bed of the channel is fine sand, the grains being about as large as those of the sand which constitutes the crest of the bar. The course of the river-sand has not been traced beyond this point, but little of it can survive the buffetings of the remaining journey and find lodgment on the bar. The sand on the bar is stirred by storm-waves, which agitate the water to considerable depths, and it also is worn to silt.

The depth of water on the bar depends not only on the rate at which sand is supplied to it but also on the strength of tidal currents. The strength of currents depends in turn on the volume of the tidal prism. The effective tidal prism is the space between the position of the water-surface in the bays when the outward flow begins at the Golden Gate and the position of the water-surface when the outward flow ends. The volume of the prism has been reduced and is being reduced in three ways: by the filling of shoals and construction of piers, by the reclamation of tidal marshes, and by the deposition on shoals in the bays of debris brought by rivers and creeks. The encroachment caused by mining debris and general soil waste has reduced the tidal prism 2 or 3%, and the encroachment from marsh-reclamation about 1.5%. Theoretically the reduction of the tidal prism should produce two changes in the bar: a migration of the crest toward the land, and an upward growth, reducing the depth of water on the crest. A comparison of charts made from surveys in 1855, 1873, and 1900 shows that in each interval between surveys the crest migrated toward the land, the entire change of position being 1000 ft. The same charts indicate a loss in depth of 6 in. between 1855 and 1873, and a gain of 1 ft. between 1873 and 1900, giving a net gain of 6 in. between 1855 and 1900, but the accuracy of these indications is questioned. The theoretic change in depth corresponding to a migration of 1000 ft. would be less than 6 in., and would be a loss instead of a gain.

A reduction of the supply of sand is theoretically sufficient to increase the depth of water on the bar, and at the same time to cause the crest to move toward the shore, but there is no independent evidence of deficient sand-supply during the period to which the survey-data pertain. The observed gain in depth may have been actual, the result of an unknown change in conditions determining sand-supply, or may have been apparent only, the result of some undiscovered defect in methods of survey.

There is no reason to believe that mining debris deposited on the bar has affected or might affect the depth of water on the bar to any appreciable extent. There is good reason to believe that mining debris and the soil-waste promoted by agriculture and other industries have reduced and will reduce the depth of water by reducing the strength of the tidal currents, their effects in this direction being combined with the similar effects of reclaiming tidal marshes on the borders of the bays. Encroachments on the tidal prism of Suisun bay have less influence on the currents in the Golden Gate than similar encroachments in the lower bays. The reclamation of marsh-lands adjoining Suisun bay and Napa river has about half as much influence on the Golden Gate currents as the reclamation of marsh lands adjoining the southern part of San Francisco bay. The currents are affected only slightly by the reclamation of marsh-lands of the river-deltas; reclamation near the river mouths tends to weaken the currents, and reclamation in the remoter parts of the deltas to strengthen them.

Phosphate in Egypt

By E. CORTESE

*Phosphate occurs in many places in Upper Egypt, along the Nile Valley, principally on the right side, and also near the Red Sea coast. Upon rocks like granite, serpentine, porphyry, and diabase comes the Cretaceous formation, containing considerable quantities of phosphate, at Gebel Duwi, Gebel Nakheil, and Gebel Kosseir El Kadim, not far from the coast. More to the north, in the hills near Safaga bay, is another rich bed. Phosphate is said to exist near Suez and in the Sinai peninsula. The formation in Egypt is variable, not only from place to place, but even within small areas. The mines are well developed on the right bank of the Nile at Sharawna and along the Red Sea coast, at Safaga and near Kosseir. The uppermost bed of the Sharawna formation is a hard limestone, 1½ to 4 ft. thick, made up entirely of oyster shells, strongly cemented by carbonate of lime. In places this changes into a true phosphatic bed; the oyster shells disappear little by little, the rock becomes softer, granulated, and in less than 1000 ft. the hard bed is transformed into fine tricalcic phosphate, assaying as high as 63%. Occasionally, the phosphate, instead of replacing the oyster bed, spreads underneath and reaches a thickness of 2.3 ft. and a percentage of 60; in other places it is 6½ ft. or more, is very hard, full of small coprolites, but is not above 25 to 35%.

The Sebaieh phosphate is already on the market, raw or ground. In parts of the desert it is estimated that there are 50 million tons of phosphate. Immense quantities of relatively low-grade material are available.

PLATINUM was discovered in the ore at the Boss mine, Clark county, Nevada, in 1914. The discovery attracted wide attention, and, according to Fred. A. Hale Jr., the production of that metal promises to become of prime importance to the district.

*Abstract: A. I. M. E., February 1918 meeting

Minerals Separation v. Butte & Superior

PART OF BRIEF FOR DEFENDANT

This is an appeal from the decision of the District Court sustaining Letters Patent No. 835,120 for Process of Ore Concentration, issued to Sulman, Picard & Ballot, on November 6, 1906, and finding the same to be infringed by the defendant, not only when it has used less than 1% of oil on the ore, but also when it has used more than 1% of oil on the ore.

Prior to January, 1917, the defendant used "oils" (among others oleic acid) in quantities below one-half of 1% on the ore. Since that date it has not used oleic acid at all, but has used other "oils" in quantities always above one-half of 1% on the ore, and for most of the time in quantities above 1% on the ore.

The court below found that prior to January, 1917, defendant infringed all the claims in issue (to wit, claims 1, 2, 3, 5, 6, 7, 9, 10, 11, 12), and that since that date it has infringed all said claims excepting claims 5, 6, and 7, which specifically relate to the use of oleic acid.

The facts presented require this Court to decide not only whether the use of more than 1% of oil infringes the patent in suit, but also whether the use of more than one-half of 1% and less than 1% of oil infringes. Thus, referring to Defendant's Exhibit No. 158, it will be seen that defendant used during the period from January 17 to 29, 1917, 0.84% of oil, and during the period from January 30 to February 3, 1917, 0.80% of oil. So also Defendant's Exhibit No. 161 shows that between February 1 and 9 the amounts of oil used daily were between 0.64% and 0.79%. Subsequently more than 1% of oil on the ore was used by defendant, as shown by said exhibits and Exhibit No. 162. The question whether the use of either of these quantities of oil constituted an infringement of plaintiffs' patent is, therefore, directly presented.

We admit that, under the authoritative and final interpretation of the patent by the Supreme Court, the use of oil in quantities of less than one-half of 1% infringed; but we contend that, under said interpretation, the use of oil in quantities above one-half of 1% does not infringe.

The patent in suit is the same patent which was before the courts in the Hyde case. In that case the learned Judge of the District of Montana *did not regard the use of a fraction of 1% of oil as of the essence of the patented process.* He therefore sustained not only the claims in issue which were in terms limited to the use of a fraction of 1% of oil (to wit, claims 1, 2, 3, 5, 6, 7, 12), but he also sustained the claims which were in terms broad enough to cover the use of any "small quantity" of oil (to wit, claims 9, 10, 11).

When the Hyde case came before this Court on appeal, an entirely different view of the invention was taken. This Court found that the *essence of the invention consists in the use of a small fraction of 1% of oil.* In its opinion it said:

"That which is presented as *new* in the patent, and as the *pivotal discovery on which its validity depends,* is the formation of a froth or scum containing the metalliferous matter produced by agitation of the pulverized ore in water, by the action of oil *in a quantity less than one per cent of the quantity of ore treated.*"

Again:

"When the claims and the description of the process of the appellees' patent are compared with the patents of the prior art, it will be seen that the *only material difference is in the smaller quantity of oil which the appellees use.*"

This court also held, as a matter of law, that the reduction in the amount of oil used to a fraction of 1% did not involve patentable subject-matter. It, therefore, remanded the case with directions to dismiss the bill.

Next, the patent in suit came before the learned Judge of the District of Delaware in the Miami case. In that case the court found, just as this court had before found, that the *essence of the invention consists in the use of a small fraction of 1% of oil.* In its opinion it said:

"The patentability of the process of the first patent in suit *resides in the use of oil in the extremely minute proportion disclosed in the descriptive portion of the patent* to effect separation of froth with its metallic particles from the remainder of the mixture by flotation. The amount there disclosed is *not in excess of 'a fraction of one per cent on the ore' and may be only one-tenth of one per cent on the ore, or even less.*"

The learned District Judge in the Miami case, however, held, as a matter of law, that the use of a small fraction of 1% of oil constituted patentable subject-matter. He therefore sustained those claims in issue there which are in terms limited to a fraction of 1% of oil (to wit, claims 1 and 12), while he *held invalid the claim in issue there which is in terms broad enough to cover the use of any "small quantity" of oil (to wit, claim 9).**

Subsequently, the Hyde case came before the Supreme Court by *certiorari.* The Supreme Court agreed with this court, and with the District Judge in the Miami case, in finding that the *use of a fraction of 1% of oil is of the essence of the invention.* It said:

"The process of the patent in suit, as described and practiced, *consists* in the use of an amount of oil which is *'critical,' and minute* as compared with the amount used in the prior processes, *'amounting to a fraction of one per cent on the ore.'*"

*Claims 10 and 11 were not put in issue in the Miami case.

Again:

"While the evidence in the case makes it clear that they discovered the final step which converted experiment into solution, 'turned failure into success,' yet the investigations preceding were so informing that this final step was not a long one, and the *patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions' 'amounting to a fraction of one per cent.'* "

While the Supreme Court held, as a matter of law, that the use of a small fraction of 1% of oil constituted patentable subject-matter, it specifically condemned the view taken by the District Judge in the Hyde case that the use of a small fraction of 1% is not of the essence of the invention. It said:

"While we thus find in favor of the validity of the patent, *we cannot agree with the District Court in regarding it valid as to all of the claims in suit.*"

It, therefore, declared invalid those claims which in terms are broad enough to cover the use of any "small quantity" of oil (to wit: claims 9, 10, and 11) and sustained only those claims which are in terms limited to the use of a "fraction of 1% of oil."

Subsequently, the Miami case came before the Circuit Court of Appeals for the Third Circuit. Since the questions of validity and scope of the patent in suit at that time had been authoritatively determined by the Supreme Court, the only questions considered were (1) the scope of the patent as determined by the Supreme Court, and (2) infringement. As to infringement, the decision of the court was not unanimous; but as to the fact that the Supreme Court had strictly limited the patent to the use of a fraction of 1% of oil, it was entirely unanimous. Discussing the contention of plaintiff in that case, that: "Whenever the modifying agent of the patent (oil) is used, a person infringes who gets air in the pulp in any fashion and agitates the mixture by any means to a sufficient extent to cause the mineral particles to attach themselves to air bubbles, and to rise therewith above the top of the mixture in a collection of bubbles and metal particles, to wit, froth," the court said:

"The contention of the plaintiff, at least, omits the *very definite limitation* of the patent to the results obtained by the use of oil *within the described proportions.*

Again it said, referring to the Supreme Court's decision:

"The District Court had held valid certain claims in which the proportion of oil was described simply as 'a small quantity,' and the Supreme Court, in reversing that finding and holding those claims invalid, used the quoted words of limitation in confining the patent to the results obtained by the use of oil in the *critical proportions of less than* 1%."

Further on in its opinion it said:

"The affinity of oil for metal was known, and, though old, was employed in the invention; but that this affinity in a given condition is greatest when its quantity is relatively least, or that the affinity increases with the decrease of oil below a given quantity (*less than* 1%), is the *soul of the discovery and was wholly new.*"

We, therefore, see that, in succession, this court in the Hyde case, the District Court of Delaware in the Miami case, the Supreme Court in the Hyde case and the Court of Appeals of the Third Circuit in the Miami case, all agreed in holding—and in so holding they all disagreed with the District Court of Montana—that the *use of a fraction of* 1% *of oil is of the essence of the patented process; and that the use of larger quantities of oil are not, and cannot be covered by the claims of the patent in suit.*

As we read the decision below in this case, it seems to us that the learned District Judge has overlooked these facts. It seems to us that he has overlooked the fact that the Supreme Court did not agree with him in finding that the patentees are entitled to cover the use of any "small quantity" of oil; but, on the contrary, that the Supreme Court agreed with this Court in finding that *the use of a small fraction of* 1% *of oil is of the essence of the patented process.* The opinion of the District Court in this case, holding that the use by defendant of 1% and more of oil infringes, seems to us to be a reaffirmance in all respects of its decision in the Hyde case, *including the errors in it which have been condemned by the Supreme Court.*

The Questions to be Decided

Since the Supreme Court has in the Hyde case authoritatively determined the rights of the plaintiffs under the patent in suit, this court at this time has only three questions to decide:

The first question is: What has the Supreme Court decided in the Hyde case as to the metes and bounds of the invention at bar, and does the use of oil in proportions greater than the so-called "critical proportions" trespass upon any just rights of the plaintiffs, as those rights have been defined by the Supreme Court?

The second question is: Is the new evidence presented in this case—evidence not before the Supreme Court in the Hyde case—of such character as, in the opinion of this court, would have led the Supreme Court to reach a different conclusion if it had been presented in the Hyde case?

The third question is: What is the purpose and effect of the so-called "disclaimer" filed by the plaintiffs after the opinion of the Supreme Court in the Hyde case was handed down?

I

The first question requires this court only to study and apply the decision of the Supreme Court. Whether we or our adversaries think it right or wrong, that decision is the law of the land with respect to the patent in suit, on the facts presented in the Hyde case. No court, except the Supreme Court itself, can change it.

This court will not listen to the defendant if it argues that the Supreme Court was wrong in finding invention

in the patent in suit on the record before it; *and for the same reason, this court will not listen to the plaintiffs when they argue, as they do argue in this case, that the Supreme Court was wrong in limiting, as it certainly did limit, the scope of the patent in suit to the use of a small fraction of* 1% *of oil on the ore.*

Defendant does not at this time, and in this place, quarrel with the decision of the Supreme Court in the Hyde case. *It is the plaintiffs who quarrel with that decision.*

In its decision the Supreme Court said:

"The process of the patent in suit, as described and practiced, consists in the use of an amount of oil which is '*critical*,' and *minute* as compared with the amount used in prior processes, '*amounting to a fraction of one per cent on the ore.*'

* * * * * *

"The experimenters were working on the Cattermole 'Metal-Sinking Process' as a basis when it was discovered that the granulation on which the process depended practically ceased when the oleic acid (oil) was reduced to about five-tenths of 1% 'on the ore.' It was observed, however, that, as the amount of oleic acid was further reduced and the granulation diminished, there was an increase in the amount of 'float froth,' which collected on the surface of the mass and that the production of this froth reached its maximum when about one-tenth of one per cent or slightly less 'on the ore' of oleic acid was used.

* * * * * *

"While we thus find in favor of the validity of the patent, we *cannot agree with the District Court in regarding it valid as to all of the claims in suit.* As we have pointed out in this opinion, there were many investigators at work in this field to which the process in suit relates when the patentees came into it, and it was while engaged in study of prior kindred processes that their discovery was made. While the evidence in this case makes it clear that they discovered the final step which converted experiment into solution, 'turned failure into success,' yet the investigations preceding were so informing that this *final step was not a long one, and the patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions,' 'amounting to a fraction of one per cent on the ore,'* and therefore the decree of this court will be that the patent is valid as to claims No. 1, 2, 3, 5, 6, 7, and 12, and that the defendant infringed these claims, but that it is *invalid as to claims* 9, 10, *and* 11."

Comparing the group of claims which was sustained with the group of claims which was condemned, we find that all the claims of both groups were limited in terms to the production of a "froth" by "agitation," and to the separation of the "froth" from the material; but that the claims which were sustained were limited in terms to the use of oil in proportions of *less than* 1% *of the ore,* while the claims which were condemned were broad enough to cover the use of a "*small quantity*" of oil. The only difference between the claims which were sustained and those which were condemned is, therefore, that the former were, while the latter were not, in terms limited to the use of less than 1% of oil on the ore. Nothing can be plainer, therefore, than that the Supreme Court has decided that the plaintiffs are entitled to a monopoly of the use of oil in the *critical proportions described in the specifications and in the proofs in the Hyde case,* but that they are *not entitled to a monopoly of the use of any larger quantities of oil.*

The only question which can arise in construing the decision of the Supreme Court is whether the use of oil in proportions between one-half of one per cent (0.5%) and one per cent (1%) falls within the monopoly of the patent. The Supreme Court says, in the passage above quoted, that the "patent must be confined to the results obtained by the use of oil within the proportions *often described in the testimony* and *in the claims* as 'critical proportions' 'amounting to a fraction of one per cent on the ore.'" The questions which arise are: What "fraction of one per cent" is here referred to? What "fraction of one per cent" is "often described in the testimony" in the Hyde case as the critical proportions? What "fraction of one per cent" is referred to in the claims as the critical proportions? To answer these questions this court must go to the patent specifications, and to the testimony which was before the Supreme Court to which it referred. It must first ascertain, therefore, what are the "critical proportions" set forth in the patent in suit.

The Critical Proportions Described in the Patent are One-Half of 1% or Less

In the introductory clause the patent refers to the Cattermole process, in which it says "an amount of oil varying from four per cent to six per cent of the *weight of the metalliferous matter present*" is employed. Simple arithmetic teaches us that 4% of the weight of the metalliferous matter in any ore which assays 25% metalliferous matter would be 1% on the ore (and an assay-value of 20% is exceptional), so that 4% on the weight of the metalliferous matter in all ores assaying less than 25% would be "a fraction of one per cent" on the ore.*

The specification continues:

"We have found that if the proportion of oily substance be *considerably reduced*—say to a fraction of one per cent on the ore—," etc.

The specifications say, in the example given beginning at page 1, line 70, that:

"To this is added a very small proportion of oleic acid (say from 0.02 *per cent to* 0.5 *per cent on the weight of ore*)."

Again they say, page 1, line 96:

"The minimum amount of oleic acid which can be used to effect the flotation of the mineral in the form of froth

*Plaintiff's expert in the Hyde case, Dr. Chandler, admitted that the Cattermole oil proportions applied to the tailing at the Broken Hill mine where the process was practiced, called for the use of only 1.2 to 1.8% on the ore.

may be *under* 0.1 *per cent* of the ore; but this proportion has been found suitable and economical."

We, therefore, see that the "critical proportions" referred to by the Supreme Court are defined in the examples contained in the specifications as being between *one-half of one per cent* (0.5%) *and one-fiftieth of one per cent* (0.02%), the preferred amount specified being *one-tenth of one per cent* (0.1%).

THE CRITICAL PROPORTIONS "OFTEN DESCRIBED IN THE TESTIMONY" IN THE HYDE CASE ARE LESS THAN ONE-HALF OF ONE PER CENT

Turning now to the record in the Hyde case, we find that the testimony referred to by the Supreme Court as defining the "critical proportions," to which the patent has been by it limited, is as follows:

In 'Complainant's Exhibit Higgins' Report of March 16, 1905' the following appears:

DETAILS OF EXPERIMENTS.

Acid.	*Oleic Acid.*	*% of Oleic*	*Time*	*Temp.*	*Remarks*
1.1%	15 cc.	3 % on ore	4 min.	30.5° C.	Very little float.
"	7½ cc.	1.5 % " "	4¼ "	31 "	Rather more float.
"	5.2 cc.	1.04 % " "	6 "	31 "	Still more float.
"	3.1 cc.	0.62 % " "	6 "	32 "	
"	1.6 cc.	*0.32* % " "	7 "	31 "	*Float vastly increased.*
"	0.5 cc.	*0.10* % " "	8 "	31 "	*Float vastly increased.*
"	0.5 cc.	0.1 % " "	4¾ "	29 "	Not finished.
"	0.4 cc.	0.8 % " "	6½ "	30.5 "	
"	0.5 cc.	0.1 % " "	8 "	31 "	
"	0.5 cc.	0.1 % " "	8 "	31 "	Weight of concs. 170 gms.
"	0.2 cc.	0.04 % " "	8 "	32 "	Apparently not much different.
"	0.1 cc.	0.002% " "	12 "	32 "	Little worse.
"	none	none	7 "	32 "	Very little float.
"	none	none	10 "	32 "	More froth.

Plaintiff's witness Dr. Chandler said:

"The inventors simply state, referring to the Cattermole patent which has just been previously discussed, that four to six per cent of the weight of metalliferous matter present is employed, that they have found that if the proportion of oily substance be considerably reduced, say to a fraction of one per cent on the ore, granulation ceases to take place. What this fraction of one per cent is, they do not mention. *The only way in which I can interpret this fraction of one per cent is by referring to other portions of the specification, where this fraction of one per cent is expressed in figures*; for example, at line 81 of page 1 of the specification is the following statement, speaking of the ore:

"'To this is added a very small proportion of oleic acid (say from 0.02 *per cent to* 0.5 *per cent* on the weight of the ore).'

"That is, from 1/50 *of one per cent up to one-half of one per cent.*"

Again, he said:

"These *extremes represent from* 0.4 *of a pound per ton of ore to* 10 *pounds per ton of ore.* The patentees do not state on what particular condition of the ore this variation of quantity depends, whether it depends upon the percentage of zinc in the ore or some other quality, but they do indicate that the selection of quantity *between these extremes* must rest with the person familiar with the art who practices the process and it is fair to assume that such person would decide how much oleic acid to use by the results of the simple preliminary tests suggested by the patentees."

Plaintiffs' witness Ballantyne testified as follows:

"I have seen the agitation-froth process carried out many hundreds of times. I have also seen investigations of the process making wide variations step by step in the factors which I have referred to above, and I have myself, on many occasions, carried out these investigations and I now know that if the instructions which Messrs. Sulman, Picard, and Ballot drew up in February, 1905, are carried out, namely, to use a slimy pulp, acidified with say 0.5% of sulphuric acid, to heat the pulp say to 30° C. and then to agitate it violently with proportions of oil beginning at 50 lb. of oil per ton of ore and repeating this test, reducing the quantity of oil step by step down to the *vanishing point,* it is inevitable that the agitation-froth shall be produced when the *quantity of oil is diminished to the limits set forth in the patent in suit,* and that a particularly good froth and efficient concentration is obtained when the proportion of oil is about 0.1% *on the ore,* the percentage recommended in the patent in suit as being suitable and economical."

In answer he said:

"In my opinion the operation of the agitation-froth process *is defined in the clearest possible terms in the patent in suit,* and this remark applies particularly to the *quantity of oil* to be used."

Further along in the same answer he said:

"I have never seen the agitation-froth process successfully carried out by the use of an amount of oil equal to practically one per cent by weight on the ore, and *in my opinion* 0.9999% *of oil would not be a proper quantity* (that is to say, it would not be a suitable and economical quantity), as contemplated by the patent, and would not therefore be a *suitable fraction of one per cent* as contemplated by the patent."

Ballot, one of the patentees of the patent in suit, said:

"The only way to carry out the process is that of applying the *proportions of oil set forth in the patent,* but to determine, as all practical men will do, which of the proportions, *within the range,* yield the best result, the characteristic nature of the froth is always an indicator which will of itself tell an experienced operator when the best conditions have been attained. * * *"

Sulman, one of the patentees of the patent in suit, examined as a witness for defendant, said:

"When we decreased the amount of oil to about 0.6% *upon the ore, granulation had ceased to appear* and a very considerable proportion of mineral was found to float to the surface as a thick froth. We still further decreased the amount of oil until we found that with 0.2 *to* 0.1% of oil on the ore *practically the whole of the mineral came to the surface as a thick blackish matted froth.*"

Picard, one of the patentees of the patent in suit, testified as follows:

"Q. 9. In the patent in suit, No. 835,120, in an example of the application of the process the amount of oleic acid used in that instance is specified as from 0.02 *to* 0.5% on the weight of ore, the latter quantity being twenty-five times the former. How would an operator practicing the process determine between these wide limits what quantity of oil to use?

"A. As a matter of fact, *both quantities mentioned are so minute* in relation to the proportion of ore that it is *hardly right to describe the limits as very wide,* but the operator would have no difficulty in determining, if there was any marked difference, which was the best quantity to use, by simply noting whether he was obtaining the specific frothing phenomenon which the patent indicates as being that required."

Ballot testified as follows:

"Q. 34. And when you saw the work in progress from March 1, 1905, onward, as referred to by you in your answer to question 29, was this the first occasion upon which you had been informed as to the use in an oil flotation process of the intentional beating in of air for the purpose of promoting flotation?

"A. The intentional beating in of air to produce or promote the flotation of froth which was developed by that process was certainly not known until the fact had been actually discovered that by using a *very small quantity of oil, say* 0.2 *or* 0.1%, and agitating it for a certain time, and then leaving the mixture to stand that the whole froth rose to the surface. * * *"

Higgins, one of plaintiffs' engineers, examined as a witness by defendant, stated, as his testimony was put in narrative form in the Supreme Court transcript, in answer to a question as to what was the "first occasion upon which you ever saw a part of the constituents of the ore, which, in the form of pulp had been oiled, floating upon the surface of the pulp" that:

"In all the slide machine tests that I have conducted I have *never had to use quantities of oily reagents outside of those mentioned in the patent in suit.* The greatest amount of oil that I have ever used in practice is *four pounds per ton of ore,* and the smallest amount I have ever used in practice is *one pound of oil per ton of ore.*"

Plaintiffs' witness, Dr. Liebmann, testified as follows:

"They inform the world what they consider the limits of their proportions, and they add that in their experience 0.1% of oil of the amount of ore has been found 'suitable and economical.' Surely one cannot demand more, and even a metallurgist of very low qualifications cannot fail to determine with the greatest ease what quantities will give him the desired results."

The foregoing is the testimony to which the Supreme Court refers in its opinion, where it says "the patent must be confined to the results obtained by the use of oil within the proportions *often described in the testimony* * * * *as 'critical proportions.'*"

What were the "critical proportions" "often described in the testimony" to which the Supreme Court has in terms limited the patent in suit? The answer is: They were less than one-half of one per cent (0.5%) of oil on the ore. It is to these proportions that the Supreme Court has limited the patent in suit. In other words, the "fraction of one per cent" of the claims is *that fraction of one per cent which is half of one per cent* (0.5%) *or less.* Any quantity of oil greater than one-half of one per cent (0.5%) on the ore is not within the scope of the patent as construed by the Supreme Court.

This construction of the patent was not only justified by the testimony in the case, but it was directly invited by plaintiffs' counsel in argument.

Plaintiffs' counsel, Mr. Kenyon, in reply to questions put by Mr. Justice McReynolds and Mr. Justice Pitney, said:

"Mr. Justice McReynolds: I would like to ask you when in this process of reducing oil your invention came into existence?

"Mr. Kenyon: At *about one-half of one per cent* of oil.

"Mr. Justice McReynolds: Before you got to the one-half of one per cent did you have any invention?

"Mr. Kenyon: We were passing from the region of Cattermole, which was a distinct—

"Mr. Justice McReynolds: *I want to know when your invention came into existence?*

"Mr. Kenyon: This invention was *not reached,* I should say, from those figures, until *about* 0.5, *that is, one-half of one per cent, of oil was reached.*

"Mr. Justice McReynolds: At one per cent you had no invention?

"Mr. Kenyon: *No.*

"Mr. Justice McReynolds: At one-half of one per cent you did have invention?

"Mr. Kenyon: *It began to come. Remote, but it began to come. At* 0.3 *of one per cent the float vastly increased. At* 0.1 *of one per cent the float again vastly increased.*

"Mr. Justice McReynolds: When this float has more than one-half of one per cent of oil it does not infringe?

"Mr. Kenyon: It does not infringe.

"Mr. Justice Pitney: What have you to say in answer to what Mr. Scott said the other day to the effect that 1.8%, or perhaps more, of oil, would give the same result with increased agitation.

"Mr. Williams: *Absolutely no.*

"Mr. Kenyon: *It would not.*

"Mr. Justice Pitney: I understood him to say so yesterday, and I supposed there was something in the record to justify it.

"Mr. Kenyon: *Nothing.* That will be a part of my argument."

Mr. Kenyon said in his oral argument in this case before the District Court that nothing was further from his intention in his answers to Mr. Justice McReynolds' inquiries than to limit the claims to one-half of 1% of oil.

In view of the proofs we do not see how he could have answered Mr. Justice McReynolds otherwise. But Mr. Kenyon's *intentions* are immaterial. The simple question here is: what were the facts and arguments presented to the Supreme Court as a basis for the decision reached?

He also said:

"It is apparent now that the inventors in their minute one-tenth of one per cent oil frothing reagent were really invoking a characteristic and a power of oil in an ore concentration process that *develops only in that relatively microscopic quantity,* and which is defeated and disappears when that minute quantity is even *slightly* exceeded, a characteristic and a power of oil which had not existed in the prior oil concentration processes of the art, which had never been utilized by anybody for ore concentration, and the very existence of which had not been known or suspected."

Complainant's counsel, Mr. Williams, in his argument before the Supreme Court said:

"The amount of oil that we use is generally one-tenth of one per cent on the ore; two pounds of oil to the short ton of ore. Every ore presents its own problem, but for a given ore and a given oil there is a certain *critical* factor. The variations in that factor in practice have been from a *trifle less than one pound of oil to the long ton in the case of the rich ores of Australia to four pounds of oil to the long ton in the case of a lean copper ore at the Braden mines in Chile.* Those are the variations of different oils and different ores, and because of those *minute variations* you have the impossibility of saying that this process always uses just so much; but given any ore and given any oil, the evidence shows that *if you add another pound of oil* your metal particles commence to stick together and commence to fall down in granules, and you get into the Cattermole sinking sphere, whereas, on the other hand, if you *diminish* it, you cease to have that selective action which is essential; you do not get any float in particular and you have gangue in it; so that it is *critical* for a given oil and a given ore, but it has variations."

Plaintiffs' counsel, in their reply brief in the Supreme Court, stated:

"It is the astonishing fact that, so far as the record here shows, with every ore the world over to which the process has been applied and with all the varying conditions of use, the *largest quantity ever used has been* 4 *pounds to the long ton (i. e., less than $\frac{8}{10}$ths of one per cent),* and that the smallest quantity has been $\frac{8}{10}$ths of a pound per long ton of ore (*i. e.*, less than $\frac{1}{2}$ of $\frac{1}{10}$th of 1 per cent)."

We see, therefore, that not only did the witnesses in the Hyde case, whose testimony is referred to by the Supreme Court in defining the critical proportions to which the patent must be limited, confine those proportions to less than one-half of 1% on the ore, but that plaintiffs' counsel emphasized this limitation in their arguments and briefs before the Supreme Court.

We, therefore, confidently submit that in limiting the invention to the "critical" proportions "often described in the testimony," the Supreme Court limited it to that fraction of 1% which is *less than one-half of* 1%, although the claims in terms are broad enough to cover any fraction of 1% (for example, 0.999%), and that *defendant has not infringed when it has used more than one-half of* 1% *of oil.*

El Boleo

A handsomely illustrated article on the mining property of the Compañía del Boleo, in Lower California, is included in the Boletin Minero, Vol. IV, No. 5. No statement of the metallurgical methods is presented, these being closely guarded by the company. The plant treats 1000 metric tons daily, the ores averaging from 4 to 5% copper. There are seven blast-furnaces in operation, with a capacity of 200 tons each per 24 hours. The ores are mainly oxidized and contain a large amount of moisture as delivered to the smelter. The products shipped are black copper assaying 93% in that metal, and matte containing 63% copper. The mines lie in three different arroyos at a distance of about 19 miles from the plant, the latter being at the port of Santa Rosalía, where a harbor has been enclosed by breakwaters built of poured slag. The ores are in the form of 'mantos' or bedded deposits, slightly inclined, resting on an extensive stratum of conglomerate. The predominant minerals are the oxides and silicates of copper, with many rare species, some containing antimony. The deposits dip at angles between 10° and 15° toward the sea, that is, to the east. Water is found at a shallow depth, which is raised by large centrifugal pumps. The roof is soft and subject to caving, which renders the problem of timbering the stopes somewhat difficult and costly. A force of 3500 workmen is employed, and a population of 11,000 persons depends upon the operation of the property. The region is a desert, nearly destitute of vegetation, and incapable of cultivation.

Regulating Explosives in California

In order to carry out the provisions of the Federal statute that provides for the licensing of all concerned in the sale and use of explosives, a California State Advisory Committee has been formed, consisting of John M. Griffin, U. S. explosives inspector for California, chairman; John A. O'Connell, of the State Council of Defense, vice-chairman; and Will J. French, of the National Safety Council, secretary. Other members of the committee are: Jay W. Stevens, H. M. Wolfin, chief mine inspector of California, Robert I. Kerr, H. D. Gaskill, Wm. J. Gardner, Edwin Higgins, and Chief of Police D. A. White of San Francisco. The executive committee comprises Messrs. Griffin, Wolfin, Gaskill, Gardner, and Stevens. The address of the secretary of the committee is at the Underwood Building, 525 Market street, San Francisco.



NEW YORK

Coal Movements and Freighting.—Cost of Living.

Coal movements on the railroads during the past year have been estimated at 60 to 160 billion ton-miles. Even the smaller estimate is gigantic, and suggests consideration of the question of unnecessary coal transport. The adoption of the zone system of coal distribution, as practised in Great Britain, might well result in haulage economies. Storage of coal on Manhattan Island (New York) is imperative if delays and heatless Mondays are to be avoided in the future; and the Fuel Administration now suggests that provision should be made by private consumers for winter needs during the spring and summer. Unfortunately facilities are generally lacking. The mild weather of late has materially helped the freighting situation, and larger supplies of coal are being received.

That the recent chaos in transportation was in part due to faulty equipment and lack of cars has been demonstrated by late statistics. At one time no less than 57 miles of track between New York and Chicago was appropriated for stalled cars needing repair. There are approximately 2½ million freight-cars in transit, and up-keep costs are naturally considerable and skilled labor scarce. The freight congestion problem has been alleviated by a new system recently inaugurated on the Pennsylvania Railroad for the handling of 'less-than-carload' lots, which has proved highly successful. Full carloads are now only carried, and 654 cars are saved daily from unnecessary service. Twenty-five local freight-trains have been discontinued, their places taken by a considerably reduced number of bi-weekly or tri-weekly 'pick-up' trains.

The Food Administration is rapidly gaining the confidence of the majority. Profiteering is still rampant in foodstuffs, but drastic action has sounded a warning note and it is generally realized that things might be much worse. One egg-juggling business was recently put out of action by the authorities and others will doubtless take note. In the case in point it was disclosed that two persons formed four companies to operate in New York to boost the prices of eggs by the simple expedient of passing the goods through the books of each company, with added increments of profit, until they finally emerged with a 'face' value some 14c. per dozen higher than the price originally paid. This case will serve as an explanation of the ability of these gentry to bluff the public with oft-repeated statements as to the insignificance of the profits made by individual concerns. The Federal Milk Commission has permitted the present high price of milk to remain in force for the present, and it is to be regretted that it were apparently unable to force a reduction. In other countries milk is milk, and guaranteed as such by the proper authorities. Here it seems to be a case of "where nature ends and art steps in," and the people have to pay for a competitive advertising war between the various controlling interests. The need for an additional 50,000 beds for tubercular patients in this country, to control the disease and prevent its spread, is a side issue; but at the present price of milk the invalid poor must content themselves with the sight of a bottle of milk pictured in an expensive adverisement. Sugar has afforded a means for profiteering by wholesalers, and in one case a refund was ordered by the Federal Food Board. This case showed that the retailer was forced to buy sugar at a price well above the highest he could possibly charge his customers. In another case a firm of New York wholesalers have had their license annuled for the duration of the War for profiteering in this article. These prosecutions show that the authorities are alive to the situation. The poor who were obliged to buy their coal from peddlers during the recent cold spells were shamefully victimized, and were forced to pay from 80 cents to $1.25 per 100 lb. Mayor Hylan intends to take steps to insure better facilities for the delivery of coal to small consumers, and a reasonable price will probably be fixed for next winter. If this proves impracticable the City will probably take over control of the matter. The increased cost of the Victory Loaf, due to the higher price of wheat substitutes, has been estimated at one-tenth of one cent. Bakers gave out that a one-cent increase would be charged and gleefully anticipated the excellent increase in profits. Mr. Hoover objects to the increase as unjustified, and the bakers' attitude naturally elicits little sympathy. The price of wheat has been virtually fixed at $2.20 since last summer, and a bill was recently proposed to raise this to $2.50 or even $3. This has now been negatived by President Wilson who has, however, promised that the farmers shall have every facility. It was generally realized that there was no justification for the proposed raise, but farmers maintained that they are entitled to rates comparable to the present price of cotton. With wheat at $2.20 they argued that an equivalent price for cotton would be 20 cents and not 32 cents as it is quoted at present. A further cause for the abnormal increases in certain expenses is the lack of recognition of a smaller coin than the nickel by certain concerns. An example of this is seen in the recently published report of a local restaurant company that caters to an immense number of the workers in offices and factories in this city. Profits show a rise of nearly 20% and this may be largely attributed to the fact that, when the increase in the price of an item on the menu is considered, at least a five-cent addition is made. Thus a large proportion of the items are increased 100% to the customer, whereas the additional cost to the restaurant is probably nearer 10%. The situation between landlords and tenants of apartments is becoming strained and remedial measures are demanded. The shortage of coal gave landlords an opportunity to repudiate their obligations, and the excuse was extended long after the coal was available to explain the absence of heat and hot water at any time the landlord wished. Tenants have practically no redress. About 80% of the population of New York City live in apartments, the majority being on a monthly tenure. The law states that a landlord may compel a tenant to vacate after a few days notice; and if the tenant objects to higher rent, entire absence of heat in a so-called steam-heated apartment, and other discomforts, he can leave, to probably meet similar treatment elsewhere. There have been no less than 32,000 dispossess or ejection proceedings commenced by landlords in this city during the winter. These cases have been the result of an attempt on the part of tenants to get common justice by withholding rent when the landlord failed to provide heat or refused to make any deduction when heat was withheld. Verdicts are invariably in favor of the tenant, and a deduction of from 10 to 20% of the rent due is

ordered by the judge. It is satisfactory that temporary redress can be obtained in this manner but the fact remains that the law is antiquated and altogether favors the landlord, leaving ample loopholes for the latter to victimize his tenants systematically. The situation is largely the result of a traffic in apartment-house leases whereby each new lessee—and he may only hold the property a few months—endeavors to make a larger profit out of the bulk payment made to the landlord than did his predecessor. If the tenant cares to take the matter of the failure to supply heat to the courts he can only claim the exact sum expended on extra gas used to warm the only room in the apartment that can be warmed—the kitchen—where he must perforce spend his time in a fume-laden atmosphere. The lessee will then probably exercise his legal right to evict him after five days notice, and numerous cases of this kind have occurred during the recent below-zero weather. Further, lessees have organized and not only are they offering effective opposition to the tenants' demands for simple justice but should a tenant object, obtain a verdict for a rebate from his rent and be immediately ejected from his apartment, his troubles do not end there. Tenants who refuse to take whatever treatment is meted out to them 'lying down' are placed on a 'black-list', and are promptly refused admittance to other houses. Legislation is being considered to remedy this pitiable state of affairs, but tenants have practically no organization, they are seldom even acquainted with their neighbors in the same house, and there are no corporate funds. It is proposed to make a landlord or lessee liable to maintain a living temperature in a steam-heated apartment or agree to a reduction in rent due. It is also suggested that landlords should be forbidden the right of ejection of tenants as long as the latter pay their rent and as long as the landlord has no just cause for complaint. One champion of tenants' rights suggests that the city should make a survey of the coal in apartment-houses, to see that landlords and lessees have purchased sufficient for the winter. In default of this the city should make the necessary supply and recoup the expense involved by a lien on the rents. The lessee evil should be abolished and landlords should be made to understand that their property holdings involve certain moral obligations; and that subletting the apartment house to an unscrupulous lessee, who may have no credit to buy sufficient coal, does not absolve them from blame. The probable spread of disease by conditions involving lack of proper ventilation and existence in a fume-laden atmosphere was anticipated in a previous letter. This forecast was justified and it is now reported that unhygienic conditions are responsible for an enormous increase, estimated at 100%, in cases of diphtheria, scarlet fever, measles, and similar complaints. The spreading of these diseases is facilitated by the congestion at normal times but quickly aggravated by the unhealthy conditions caused by the rank profiteering of many lessees and landlords. Preventable waste at such times as this is a tragedy and it is unfortunate that a section of the community regards the question from one standpoint only, that of material and personal loss. Wastage of labor caused by the unthinking few and paid for by all is a serious factor in the present cost of living. Shoppers may be divided into two classes, namely, those that have an intelligent conception of what they want to buy, and those that systematically purchase almost anything they see, knowing full well that they will avail themselves of the return privilege. A reliable authority has stated that 25% of the goods bought in retail stores are returned. The great bulk of the shopping public seldom or never takes advantage of this facility, but this section has to pay for the indecision of those individuals who help to materially raise the ultimate cost of retail goods by doubling or trebling the labor involved for each transaction, and by depreciating the value of the goods they handle 'on approval'. This evil is particularly noticeable in New York where wastage of this kind is rampant.

CRIPPLE CREEK, COLORADO

LEASING AND DUMP TREATMENT.

Victory Gold Mining Co. has purchased the Elmer Smith lease on the Howard shaft and 5 leased blocks of the Mary McKinney Mining Co.'s estate on Gold hill. Consideration is reported to have been $10,000. The Howard flats have produced approximately $2000 gross, and the property, with large area undeveloped, is still producing heavily.

Wild Horse shaft, at east end of Wild Horse mine on Bull hill, has been leased to Crook and Pratt, who will mine ore from a dike extending south of a line between the Wild Horse and Gleason shafts. This dike measures from 75 to 100 ft. in width, and carries gold-bearing clay. Ore can be mined profitably, with low treatment charges prevailing. Property is owned by the United Gold Mines Company.

Dumps on El Paso Consolidated property on Beacon hill are to be shipped to Golden Cycle mill at Colorado Springs, at the rate of a carload daily. Careful samples have shown an average of $3.10 per ton. This can be treated profitably.

Large quantity of dump ore continues to move from the Stratton estate to the Golden Cycle mill at Colorado Springs, also Portland and Independence mills at Cripple Creek.

LEADVILLE, COLORADO

DRESSING MANGANESE ORE.—IRON-SILVER ORE DEVELOPED.—GOLD IN THE IBEX.

The first 100-ton unit of the Star Consolidated Mining Co.'s 300-ton mill has been completed by G. E. Cramer. A trial was made last week, and after necessary adjustments will be ready for regular operation. Capacity is expected by the end of March. This plant will dress ore from large bodies of low-grade iron-manganese deposits. Manganese content of crude ore ranges from 15 to 20%, and concentrate is expected to contain 30% and low in silica, a marketable product. Treatment is as follows: Ore is hoisted through No. 5 Star and Ladder shafts, 200 ft. on either side of the mill, and trammed over trestles to receiving-bins. These feed a revolving-screen with 1-in. holes. Coarse ore from screen is shoveled into a crusher. Fine ore from screen and crushed ore drop into another chute feeding a belt-conveyor. This carries ore to the top floor of the mill, where it goes through another screen with ½-in. holes. The oversize is fed direct to a Chalmers & Williams disc-crusher. After passing through screen and crusher, all ore is ½ inch or under, and drops into a bin on the lower floor. From this it is elevated by two belt-conveyors to feed-tanks on second floor. From tanks the ore and water flow to jigs that separate the silica from the iron and manganese. Coarse concentrate is caught on the upper jigs and fine material on a lower set. The silica is washed off into a settling-tank, from where it is trammed to dump. Concentrate is put in bins on bottom floor, trammed to an elevator near railroad, and dumped directly into cars. The plant is heated by exhaust from the large steam hoists at the shafts. Construction will be started on No. 2 and 3 units when No. 1 is in complete order. Cost of mill when complete is estimated at $50,000. Mr. Cramer is producing 200 tons of manganese daily, marketable without concentration. Some lead ore is also being shipped.

Manganese ore in considerable quantities was opened in the Jason mine in Poverty Flat district, and Mrs. F. M. Doty of Denver, who recently sold her lease on the property for $10,000, has acquired a lease on the S. Small ground adjoining. She believes that the Jason deposit extends into these claims. The Seeley shaft is to be equipped with hoist, etc., re-timbered to 300 ft., and exploration started.

Development at the new Dunkin shaft on Fryer hill is proving that property to contain the largest and highest grade iron-silver deposit in the district. Ore was first found at a depth of 80 ft., underlying a stratum of flint. Shaft is now

over 100 ft. deep, the bottom in ore. Driving into the deposit in two directions shows the shoot to be continuous so far. Shipments were started last month, but shortage of cars has prevented operations at capacity. It is estimated that 5000 tons of ore is blocked out, and production will be from 50 to 100 tons daily after April 1.

High-grade gold ore has again been discovered in the Ibex mine on Breece hill, the first time in many months. Recent discoveries were made in widely-separated parts of the property. Snowstorms have hampered work at this interesting mine.

Lessees at the Nisi Prius mine in Iowa gulch, where a large body of manganese was discovered last year, are to sink their shaft another 50 ft. in the spring. Shipments are now 50 tons of manganese daily. The deposit is persistent below the present workings, and deeper workings are expected to find better ore.

HANOVER, NEW MEXICO

IRON, ZINC, AND SILVER PROPERTIES OF FIERRO, HANOVER, AND KINGSTON

KINGSTON.—Empire Zinc Co.'s work in this field and the rise in silver has resulted in more work being done here during the past year than in the preceding decade. The Empire company has started development on the Grey Eagle group. Its total holdings approximate 50 claims.

Franklin company, on Bullion hill, has resumed work. Both shipping and milling ore is being developed, and future prospects are good.

This district was formerly a large silver producer, and present prices make prospecting worth while. The real future of Kingston depends on the successful exploitation of its zinc deposits. The fact that so conservative a corporation as the Empire Zinc Co. has taken large holdings here, remote from railroad transportation, augurs well for future possibilities.

HANOVER.—Republic M. & M. Co., driving east on an orebody on the 150-ft. level, has opened ore assaying as broken over 40% zinc. On the 200-ft. level a fine body of 20% milling ore is being developed. This mine, a prospect a year ago, has approximately 100,000 tons of minable ore averaging 15% zinc.

United States Copper Co. is making good progress in sinking its No. 2 shaft. Station at 400 ft. will be cut this week. It is reported that ore has been found between the 300 and 400-ft. levels.

FIERRO.—Hanover Bessemer Iron & Copper Co. is shipping 20,000 tons of iron ore per month to the Pueblo plant of the Colorado Fuel & Iron Co. The present contract calls for this quantity for 10 years. This company is also shipping ore to the Copper Queen smelter at the rate of 900 tons per month. It averages nearly 5% copper and 50% iron.

SUTTER CREEK, CALIFORNIA

ARGONAUT AND CENTRAL EUREKA SINKING SHAFTS.

JACKSON.—Argonaut company is again preparing to deepen its shaft 150 ft. It is 4785 ft. deep on an incline of about 60°, equivalent to a vertical depth of 4145 ft. To facilitate hauling ore, a large hoist was installed at the 3900-ft. station a few years ago. This machine is practically a duplicate of that on the surface, and is the largest underground hoist on the Mother Lode. Ore is being hoisted from the lowest levels of the mine. Orebodies at 4500 ft. are yielding good ore, so are the 3600, 3750, 3900, and 4050-ft. levels. The vein is regular, averaging from 8 to 12 ft. in width, being of fine value throughout. The 500-hp. double-drum electric hoist on surface brings the ore from 3900 ft. to surface in 4-ton skips. It is there automatically dumped into storage-bins in the head-frame, and from there conveyed to the new 60-stamp mill just west of the shaft. N. S. Kelsey is manager of this dividend-payer.

SUTTER CREEK.—At Central Eureka mine the shaft has been sunk 30 ft. below the 3425-ft. level, two shifts engaged. Specimen ore has been found several times recently at 3350 ft., where stoping is in progress, and the average of ore being extracted from this level is increasing mill-ore encouragingly. While indications are good for pay-ore near present bottom of mine, no permanent station was cut below 3350 ft. when sinking was discontinued early last year, it being deemed best to increase the depth before attempting extensive lateral development.



NORTH CAMP, KELLY, NEW MEXICO

TINTIC, UTAH

ACTIVITIES IN EAST AND WEST TINTIC, EUREKA, MAMMOTH, AND SILVER CITY.

EAST TINTIC.—Considerable new work is to be done in this district during the coming season, both by companies already operating, and by others preparing to enter the field. In the North Tintic area there will also be extensive exploration.

EUREKA.—Lehi-Tintic has opened rich copper-silver ore at a point 2000 ft. in its adit and depth of 600 ft. At bottom of 50-ft. winze is 3 ft. of ore. A new air-hoist is being installed to sink deeper on this shoot. As soon as roads are dry shipments are to be commenced.

Tintic Standard company is to sink three shafts. One, in central part of property, is down 175 ft. below the adit-level.

Another is to be started early in the summer, and the third will be sunk near the Zuma property. The Standard ground is so extensive that three shafts are necessary for quick development.

Eagle & Blue Bell shipped 80 cars of ore during February. This is the maximum allowed by the smelter. Station is being cut on 2000-ft. level, after which a drift will be driven to cut the vein, probably 300 ft. from shaft.

North Beck Mining Co.'s shaft is down 700 ft., on its way to 1000-ft. depth.

At depth of over 500 ft. in Copper Leaf shaft, gas was encountered, necessitating installation of a blower. Work is suspended until this is done.

MAMMOTH.—Grand Central shipped 100 tons of ore daily in February. Much of this is coming from an apparently new orebody, being developed by three raises above 2000-ft. level.

SILVER CITY.—Tintic Milling Co.'s plant is working well, according to the manager, G. H. Dern, treating ore from the Dragon, Iron Blossom, and other mines. February output was worth about $70,000.

WEST TINTIC.—Operators in this and the Erickson district are highly satisfied on account of the railway to be constructed into the region.

COLEMAN, TEXAS

OIL DEVELOPMENTS IN COLEMAN, PALO PINTO, AND STEPHENS COUNTIES

All of that region in which the Pennsylvanian rocks outcrop, and a large part of that covered by Permian rocks, from Wichita Falls to Brady, north and south, and Parker county to Scurry county east and west, is being covered by lessees for oil and gas.

There are several good wells in Stephens county yielding over 100 bbl. per day. The McClusky well at Ranger, Eastland county, is the only real well in this part of Texas. It is about four months old, and still flowing over 1000 bbl. This well is 3440 ft. deep, and oil comes from the Bend series.

The Lee well at Caddo, Stephens county, is 3181 ft. deep. Its production is from the Bend also, and is good for 200 barrels.

The Morris well, 9½ miles north-east of Coleman, Coleman county, owned by the Magnolia Elizabeth company, is 3450 ft. deep. Oil comes from the Bend series. This well is good for 35 bbl. per day.

At Brownwood, 400 wells have been drilled. These are from 200 to 600 ft. deep. Companies drill four to eight wells on a town lot. Average well at Brownwood is good for about two barrels per day.

Engineers would be interested in the equipment at these wells. Anything that will punch a hole is used, and the casing in many cases is galvanized sheet-iron drain-pipe. Leases at Brownwood have sold 'very high,' in some instances they are asking as much as $400 per acre bonus and ⅛ royalty for town lots, 1½-acre plots. Lease men are paying 50c. to $10 per acre. Average bonus is about $1. A lease carries ⅛ royalty and $1 per acre rental per year.

A 'spring drive' on the 'general public' is under way. Some $20,000,000 oil companies will soon be selling stock, and the unsuspecting public will be easy 'meat.' At present there is nothing here to justify the boom. However, there are several areas in this region well worth prospecting, and from which oil in commercial quantities will be produced; but something should be done at once to protect the people from stock-selling 'sharks.'

The Texas & Pacific Coal Co. has the largest production at present in this region. It owns the Ranger well, mentioned above; and owned so many leases that it was lease poor, and had it not been for the Prairie Oil & Gas Co. coming to the rescue recently it would have lost its leases or gone bankrupt paying rentals. There are lots of 'lease hogs' in this region.

The Prairie company has acquired a half working-interest in a large part of the T. & P. Coal Co.'s holdings. It secured all of the producing area except the old Strawn field. The Prairie will most likely construct a pipe-line to the field, and from reports will drill 20 wells for the T. & P. company. For this it gets a half interest in the property. T. & P. shares are selling around 318. Stock of this company has just been increased from $4,000,000 to $5,000,000, evidence of the 'trend of the times.'

TORONTO, ONTARIO

LABOR SITUATION IN ONTARIO.—PORCUPINE, KIRKLAND LAKE, AND FORT MATACHEWAN.

Labor conditions in mining regions of northern Ontario are gradually improving. At Cobalt, Kirkland Lake, and outlying districts, mine managers state that they have no difficulty in securing all the men they need. Conditions at Porcupine are rather less satisfactory, as owing to the policy of the Hollinger and McIntyre in paying much higher wages than the general rate, there is dissatisfaction and restlessness among those employed elsewhere, and men are disposed to leave and look for work in preference to accepting a moderate wage.

PORCUPINE.—McIntyre is steadily improving its position. Gross profits are 25% of issued capital. Three shafts are down 1000 ft., and main workings are being sunk to the 1325-ft. level. Width and value of the orebodies is found to increase with depth, and ore-reserves are worth approximately $6,000,000. Average gold content is $10 per ton.

Dome Mines Co. is working on a comparatively small scale, practically confined to sinking the main shaft from 800 to 1000-ft. level. This may be continued to 1500 ft. Work is being done directly by the company and not under contract, as was originally proposed.

Dome Lake has cut a high-grade orebody for 110 ft. An extension of No. 3 vein has been cut on 400-ft. level, 750 ft. from main shaft. It is heavily mineralized, and shows free gold.

Davidson mine was inspected on February 18 by a large party of Toronto, Buffalo, and Detroit business-men. Ore blocked out down to 200-ft. level is estimated at 100,000 tons, averaging $10 per ton. Large bodies of low-grade ore are considered to exist below 200-ft. level.

KIRKLAND LAKE.—Development of this goldfield is handicapped by high cost of mining and milling, about $10 per ton. In addition to the increased cost of labor and supplies, disadvantages are hard rock, lack of persistence in ore-shoots, and undesirable minerals rendering treatment difficult. Graphite is one of these interferences. Richness of much of the ore is expected to overcome this drawback, and opening of new mines, increased milling facilities, and reduction in present high costs may enable $8 and $10 ore to be profitably mined.

Teck-Hughes in January treated 2177 tons of $8.62 ore, a considerable increase over any previous month.

Elliott-Kirkland cross-cut on 400-ft. level has passed through 28 ft. of vein formation, part of which is said to be high grade.

Canadian-Kirkland shaft on No. 2 vein is down 75 ft., at which point ore assays from $3 to $12 per ton. Ore from No. 1 vein, at a depth of 35 ft., is richer.

FORT MATACHEWAN.—Increasing interest is being taken in this gold district, which is about 38 miles up the Montreal river from Elk Lake, and includes the townships of Powell, Cairo, Alma, and Yarrow. Recent sale of the Otisse property for a large sum brought the field prominently into notice, and a good deal of capital is seeking investment here. The first claims were staked in the district previous to the discovery of silver at Cobalt. There was a rush of prospectors in 1911, and another last year, when 1000 claims were located. Value of the field has yet to be determined, and it is expected to be the scene of much activity as soon as spring sets in.



ALASKA

JUNEAU.—Estimates for February operations at Alaska Juneau are as follows:

Ore milled, tons		97,155
Assay of mill-feed, cents per ton	60	
Assay of tailing, cents per ton	15	
Gold recovered, cents per ton	45	or $44,000
Cost of milling, cents per ton	46	
Cost of mining and tramming, cents per ton	20	
General charges, cents per ton	4	
Total operating expenditure	70	or 69,000
Operating loss		$25,000
Expenditure on capital account		21,000
San Francisco charges		5,580
Total estimated expenditure		$95,580

F. W. Bradley states that the low value of the mill-feed is due to excessive mixture of waste with the ore, caused by what has turned out to be an erroneous lay-out of the pre-mining work. To overcome this, the new, or 410 stope, is now being opened with a cut-out area on February 10 of 18,434 sq. ft., assaying, up to that date, $1.49 per ton. Maximum crushing capacity of the whole mill for February was only 3470 tons per day. Mill is not only a disappointment in its small capacity, but also in its high costs. These defects can be somewhat overcome by rejecting coarse waste before any fine grinding. Pending completion of an installation for this purpose, the plant will hereafter be operated but one 8-hour shift per 24 hours.

ARIZONA

AJO.—Powder in drill-hole in steam-shovel pit of New Cornelia became ignited on February 27, resulting in explosion that killed two men. This is company's first fatality.

GLOBE.—Adjoining the New Dominion and Big Johnny properties the Moline-Arizona Copper Co. is to develop the old Mineral Farm mine. B. F. Baker is in charge at Globe.

JEROME.—United Verde Copper Co. has stopped night shift, and will operate the mine with two 8-hour shifts with more men.

Court has ousted A. B. Frame from the Jerome-Portland, and directed that the stock held for him in escrow be placed in treasury of company.

Considerable trouble is being experienced with water at the Gadsden mine. Additional pumps are required.

Jerome Grande company, which has taken over the Verde Grande, is to unwater shaft and start development.

A 70-hp. boiler and 4-drill compressor have been purchased for the Annie Gold mine for sinking shaft to 500-ft. level from present 160-ft. level. About 3000 ft. of work has been done.

Jerome Daisy has been forced to close down for lack of funds. Shaft has reached a depth of 250 feet.

General Development Co. (Lewisohns) is reported to have paid $50,000 toward further control of Jerome Copper Mining Company.

Adams and Townsend are shipping tungsten concentrates from their property in the Aquaris mountains. Concentration is done by hand-jigs, owing to shortage of water.

KINGMAN.—Much of the active and profitable operations of the mining industry of north-western Arizona can be credited to the service of the Desert Power & Water Co. of Kingman, a concern that now has an investment of $750,000, with lines extending to Oatman, Chloride, and other producing districts. Improvements made during the past year cost $200,000, including a 3000-hp. Allis-Chalmers turbo-generator, with corresponding boiler additions. At an expense of $90,000 a line is to be constructed to Hackberry, and another will extend to Cyclopic camp, 30 miles north of Chloride. A new customer is the Gold Road, lately revived; while the Schuylkill company at Chloride will take the place of the Tennessee, lately taken over by the Schuylkill.

KOFA.—King of Arizona gold mine in Yuma county is reported sold for $50,000 to J. W. Johnson, representing Eastern people.

METCALF.—Mines of the Clifton-Morenci-Metcalf district are gradually increasing their forces, having about two-thirds normal number at work. In accordance with ruling of Federal Board, only married men who worked immediately before the strike are being employed. This ruling does not apply to skilled men.

Arizona Copper Co.'s concentrator at Clifton is in operation, ore coming from the Metcalf mines. This company is preparing to churn-drill in the Metcalf district. Two 1500-ft. Armstrong drills of latest type are to be in operation shortly. They are equipped with 25-hp. motors. Sites for 16 holes have been located and a road to them is completed. Depth of first holes will be 1000 to 1500 ft. The area to be drilled has never been prospected, but the surface indications are good, and it is expected that valuable orebodies will be discovered.

MIAMI.—Inspiration Consolidated is operating at 80% capacity.

OATMAN.—Two Calyx drills have arrived here; one is to be installed at the Telluride and the other at the Amalgamated. Engine used for operating hoist at Ivanhoe shaft will supply power for drills. These are capable of cutting a 6-in. core.

TUCSON.—Projects to erect reduction works near here are as follows:

Pima Smelter & Refining Co. has been incorporated by Alford Roos, G. P. Myers, and J. W. Bogan, capital $1,000,000, to move a smelter from Socorro, New Mexico, to Tucson. Another scheme was to raise $750,000 at Tuscon and $2,500,000 elsewhere, and erect a large plant within two years. Third idea was to build a large concentrator to treat tungsten, molybdenite, and other rare ores.

A. Roos states that the smelter project at Tucson is practically financed, and the plant will be shipped from Socorro in 10 days.

CALIFORNIA

Report of Industrial Accident Commission for year ended June 30, 1917, has just been published. It covers 158 pages, and is replete with charts, tables, and interesting data dealing with accidents, compensation, insurance, and safety.

Platinum resources of this State and Oregan have been investigated by U. S. Geological Survey and State Mining Bureau, who summarize as follows:

Possibility of increasing production of platinum metals depends on improvements in recovery methods now used, on ex-

tension of these methods to areas that are known to contain these metals but that have not yet been mined, and on discovery of new productive ground in north-western California and south-western Oregon, where prospects seem good. Streams that carry insufficient gold and platinum to pay for mining at former prices might now yield a profit. Streams that drain areas of serpentine would seem to be particularly favorable for prospecting. At no place are the platinum metals concentrated in large quantities. Being rarer than gold, they are harder to find than the yellow metal. Iridium is in great demand, and the fact that it forms 10 to 40% of platinum metals in nearly all the placer deposits in United States is a special incentive to search for more of them. Risk that must be taken to find and develop new sources of supply is great, but the pressing need would seem to justify it. Elimination of litigation and equitable settlement of questions regarding surface rights and underground rights in drift mining, and regarding the distribution of water for irrigation, power-plants, and mining might also increase the output. Present price of platinum metals, which is much higher than that of gold, does its share in encouraging production.

ALLEGHANY.—In suit of Sixteen-to-One Mining Co. v. Twenty-One Mining Co., dispute over certain mineral land, District Court at San Francisco gave title to plaintiff; and in suit between same parties for $100,000 damage for ore extracted during alleged trespass, plaintiff also won, but as there was no wilful trespass, cost of mining was to be deducted from the $100,000. As this cost was not fixed by the jury, the verdict was faulty, and no judgment was entered. A re-trial will fix the cost.

ALMADEN.—New Almaden company is demolishing old distillation furnaces, foundations, and flues; washing the loose material, and has one furnace treating brick saturated with quicksilver. A fair quantity of mercury is being recovered. Save for lessees the old mine is idle. At the company's Senator mine, 7 miles distant, two furnaces are distilling metal from cinnabar.

ATOLIA.—Atolia Mining Co. held its annual meeting at San Francisco on February 21, and the following board of directors was elected: E. C. Voorheis, president; F. W. Bradley, vice-president; E. A. Stent, secretary; with C. H. Kroll and David Atkins.

CORAM.—First National Copper Co., operating the Balaklala mine, declared dividend of 15c. February 25. Three hundred tons of ore is shipped daily to Kennett smelter under contract in force for next seven years. Recent work in new ground is reported to have opened good ore.

Shasta King, the principal mine of the Trinity Copper group, is being worked by the United States Smelting company under bond and option. More men have been engaged preliminary to a larger output.

CRUCERO.—Tecopa Mines Co. may erect a smelter either at this place or at Tecopa. L. D. Godshall of Los Angeles is in control.

OROVILLE.—At an elevation of 1150 ft. above sea-level and 750 ft. above the Feather river in Butte county, and 14 miles from Oroville on the Western Pacific, are the California National Gold Mining Co.'s claims. Property was examined in 1917 by Chester F. Lee, and Morton Webber. It is now under development, and is expected by management (C. H. Waters in charge) that it may prove to be one of the largest low-grade properties in this State. Various assays indicate an average of $2.50 gold per ton, although one gave $1.90. This is the feature of this mine: a large deposit of soft low-grade ore, well situated for mining by adits, and simple treatment. If $2 per ton is extracted, total costs are not expected to be over $1 per ton. The deposit seems to be a replacement of amphibolite country-rock by silicious and ferruginous matter. Observed minerals are quartz, decomposed feldspathic matter, and finely-disseminated iron pyrite. The body is stated to be 480 ft. wide at right angles to the dip. No work has been done to determine its length. Company has an 11-mile ditch and flume, and plenty of water.

PLACERVILLE.—Pacific Gold Mining Co., operating Martinez mine, has driven a 1000-ft. adit, opening mine to depth of 520 ft. Low-grade ore was opened several months ago.

In Red Wing mine, near the Martinez, 200-ft. level cross-cut



CALIFORNIA NATIONAL PROPERTY IN FEATHER RIVER CANYON, NEAR OROVILLE, CALIFORNIA

is in 330 ft., cutting veins from 3 to 14 in. wide, assaying $15 per ton.

Cincinnati mill is crushing $3 to $4 ore, said to be mined and treated at cost of $1 per ton.

WINTHROP.—Bully Hill mine is producing 100 tons daily, shipping to Kennett smelter. Good ore has been opened on 900-ft. level and drilling is to prospect at depth of 1100 ft. Bully Hill is being developed by the Arnstein company, under a bond and option, and it is reported that a flotation plant may be installed soon.

COLORADO

CARIBOU.—Despite winter weather several properties are shipping ore.

Caribou company has erected a compressor and re-timbered its shaft. No. 10 level is to be driven in new ground. Part of old ground is to be leased. Company has acquired Grand County claims adjacent.

LEADVILLE.—Climax Molybdenum Co.'s new mill is working well, producing high-grade concentrate. H. L. Brown is in charge.

Molybdenum Products Co. is building a mill at Burfehr's spur. A. B. Scott is manager.

Wilson mill at Frawley, formerly Robinson, has been overhauled to treat lead-zinc ore.

NEDERLAND.—Malmo Mining & Milling Co. has been organized by C. E. Bradenburg and Eastern people. Machinery is to be ordered. Property is considered to have good possibilities.

I. N. Bair and others have secured the Catastrophe tungsten mine in Boulder canyon. Ore is rich in ferberite.

Rare Metals Co.'s mill at Rollinsville, 4 miles from Nederland, is to resume ore-dressing, in charge of Nelson Franklin.

Cross tungsten mine at Cold Springs is showing one of the best deposits in the county. Wolfe Tongue company is owner.

Potosi mine at Caribou is developing rich silver ore. Shipments are to be made regularly.

Country between Cardinal station and Caribou will be extensively explored this year.

IDAHO

LEADORE.—Sunset mine near this place requires a mill for profitable operation. A carload of silver-lead ore daily was sent to Utah during last summer, but this only paid expenses. Reserves are estimated at 400,000 tons. C. O. McFall is largely interested in this, the Greenback, and Salmon River mines nearby.

MULLAN.—Federal M. & S. Co. pays 1¾% dividend on March 15, equal to $209,757. This is on preferred shares. The Morning mill is again treating ore.

Development in Copper King Mining & Smelting Co.'s ground has been changed to driving east on high-grade milling ore, and west on 6 ft. of rich copper ore. Samuel Edelstein is president.

National Copper Mining Co.'s 500-ton mill is working at part capacity, producing over 300 tons of concentrate per month. No. 12, 14, and 15 levels supply the ore. No. 15 is 2200 ft. from the surface. A little profit is being made. Charles McKinnis is manager.

Donald F. Fitzgerald, promoter of Mineral Farm Mining Co., and former president of a brokerage concern with offices in St. Louis, Detroit, and Chicago, pleaded guilty in Federal Court at St. Louis on March 4 to a charge of using the mails to defraud. He was sentenced to two years in the Leavenworth Federal prison. Information gathered by Federal authorities indicated that 200,000 shares in Mineral Farm company had been sold at the St. Louis brokerage office since 1916, and that no dividends had been paid.

MICHIGAN

HOUGHTON.—Wolverine company is trying mules for underground tramming, also a compressed-air shovel to load cars. This shovel fills a car in 2½ minutes, against 10 minutes by 3 men. Trammers are short, and mechanical systems will help this deficiency.

Mayflower-Old Colony shaft is down 240 ft. Modern surface plant is complete. Shaft must be sunk to 2100 ft. before lode is cut.

Franklin No. 2 shaft is down to No. 18 level, where station is being cut. Daily shipments are 1200 tons.

Ahmeek is shipping 4300 tons per day.

Mass Consolidated production in 1917 consisted of 30% mass and 'barrel' copper. Total output was 4,000,000 lb. Costs were 19c. per lb. Over $80,000 was spent in construction, mostly employees' homes.

MONTANA

BUTTE.—Alice zinc mine of Anaconda group resumed operations last week, after 9 months shut-down. Leo McGrath will be in charge of 150 men, producing over 200 tons daily.

West side of this district is receiving additional attention. Butte & Plutus Mining Co. is latest company to start work. A two-compartment shaft is being sunk 100 ft. north of Hibernia claim of Davis-Daly, and 300 ft. from Nettie claim of Anaconda. Vein carries silver, also manganese. D. J. McGrath is manager.

North Butte company has purchased Monitor claim on east side for $150,000 cash.

HELENA.—Helena mine has dispatched 47 carloads of ore to smelter, and ore-shoot, which is 200 ft. long, continues strong above 300-ft. level.

New 80-hp. boiler has been added to Looby shaft of Cruse Consolidated. Shaft is to be deepened below 150-ft. level.

A. B. Woolvin, of New York and Duluth, has secured option on the Byrnes-Coffee claims, and is expected to acquire control shortly.

Rock Rose Mining Co. is shipping a good grade of lead-silver ore to smelter.

Thomas Cruse Development Co. is making regular shipments from above 640-ft. level.

NEVADA

GOODSPRINGS.—Favorable reports have been published regarding the Red Streak Copper, Copper Chief, Copper Peak, and Oro Amigo mines; also at 900 ft. depth in the Yellow Pine.

During 1917 the Yellow Pine Mining Co. produced 20,165 tons of ore, 11,664,820 lb. of zinc, 4,984,338 lb. lead, and 125,246 oz. silver, making a profit of $653,199. Dividends totaled $360,000. The cash revenue is $230,000. The important development of the year was on the 700-ft. level. A number of improvements were made to surface equipment.

JARBIDGE.—Elkoro Mines Co. has started its new 150-ton cyanide mill. Plant is operated by electricity, generated at Thousand Springs. Aerial tram carries ore from mine to mill. Development has been in progress two years, and opened plenty of ore for a long run.

KIMBERLY.—Giroux mill of Consolidated Coppermines resumed ore-dressing last week, after several weeks suspension. Mine developments are reported as encouraging.

LAS VEGAS.—Manganese Association, leasing a large manganese deposit, near here, has, it is reported, closed a contract to supply Suffern & Co. of New York with 90,000 tons. Price on cars in the East is $42 per ton. Said to be 150,000 tons available.

LOGANDALE.—Cinnabar is reported to have been found 6 miles west of this place in Clark county. Locators were D. A. Potter, Henry Rice Jr., and others. Ore assays up to 10% mercury.

MILL CITY.—Tungsten is being mined from a new area 8 miles west of this place on the S. P. line. Lessees are busy. During February, Friedman extracted ore worth $30,000; while Forge and Stouk took out $20,000 in 60 days. Property of Thomas Sutton shows good ore at 100-ft. depth.

PIOCHE.—Prince Consolidated in February produced 12,000 tons of ore. The mine is in good shape to continue yielding 400 tons daily. Regular dividends were paid to end of 1917, but were suspended until taxation is decided.

TONOPAH.—Production during week of March 2 was 10,581 tons valued at $179,877; and last week 8873 tons worth $150,841.

Tonopah Extension in January yielded 862 oz. gold, 87,321 oz. silver, and profit of $13,459 from 8877 tons of ore.

PIONEER.—Consolidated Mayflower company has opened a good deal of high-grade ore, and is shipping some to the Mammoth smelter in California. A recent carload assayed $22 per ton, mostly gold. Part of the mill is operating, and 15 stamps will be dropping in near future.

OKLAHOMA

COMMERCE.—Big Seven Lead & Zinc Mining Co. is constructing surface tram and tunnel to connect its mines with the mill and mines of its Queen City property, recently acquired. This will improve moving ore at less cost.

PICHER.—Kanoak Metals Co. has two mills operating at

Picher, a third is under construction at Douthat, and a fourth is to be built near Badger. One of the Picher plants treats 450 tons of ore daily. Ore is mined at a depth of 190 ft., and averages 8.2% blende and lead. A. M. Gaines is in charge.

QUAPAW.—Kentex Mining Co. contemplates erection of mining and milling plant costing $100,000. S. C. Kennedy is manager.

Lucky Joe Mining Co. is erecting a 250-ton mill near Quapaw. J. P. Matthews is manager.

OREGON

Geology of the Oregon Cascades is summarized by Warren DuPre Smith in Bulletin 16 of the University of Oregon, at Eugene. Geological history of California and Oregon are considered to be much the same. In the metamorphic rocks is serpentine, carrying chrome ore, also some nickel and copper. In the younger sediments is a fine diatomaceous earth. The recent gravel areas have yielded some of the best gold by placer operations. These are the most important economic points in the publication.

GOLD HILL.—Decision of considerable importance to miners in this region was given this week at the United States Land Office at Roseburg, in a contest for Government land, between J. H. Beeman and E. J. Jamison. Judgment was in favor of Beeman, the mineral claimant, and against Jamison, the agricultural claimant. Several years ago Jamison located a homestead of 160 acres on Government land, which includes the quarry tract selected for the State limestone plant at Gold Hill. Later, Beeman and others discovered the lime deposits on the homestead, and located three claims of 60 acres thereon; and on the recent application of Jamison for a patent for his homestead, Beeman filed a contest, claiming the land more valuable for mineral than agricultural purposes. The decree gives Jamison a patent for the homestead, saving and excepting the mineral land of 60 acres, which is given to Beeman.

MEDFORD.—Lee Devenport of Portland has arrived here with oil-drilling machinery to exploit the recently reported discovery of asphaltum deposits east of Ashland, in the hills at the head of Antelope valley. It appears that large deposits of high-grade asphaltum have been uncovered in carbonaceous shale, with evidences of petroleum.

UTAH

ALTA.—Cottonwood district continues busy. Columbus-Rexall has 800 to 1000 tons of ore broken; Emma is shipping a carload daily; Michigan-Utah is soon to start shipments; while Sells and South Hecla are sending out ore. Snow is deep, but roads are good.

BINGHAM.—Utah Metals & Tunnel Co. has suspended ore shipments until lead prices improve. All properties of this company are opening well.

EUREKA.—Railroad may be constructed to West Tintic and Erickson districts. The Salt Lake, Fillmore & Kanosh Railroad has been organized with capital of $500,000, mostly by Provo people. G. W. Craig of the Salt Lake Route is president. It is intended to build a standard-gauge, single-track line from Lynndyl south-east to Kanosh, by way of Holden, Fillmore, and Meadow, a distance of 50 miles. In addition, a 25-mile branch to north-west of Lynndyl, taking in the West Tintic district. Both of these branches will be valuable feeders for the Salt Lake Route.

DUGWAY.—This district was recently examined by Pierre Peugeot, consulting engineer to the Dugway Smelting Co. Dugway Bertha has 200 tons good ore on dump, and is mining more. Luck Star development is good. Piedmont shows copper in 15 openings; also some bismuth at depth of 220 ft. Hidden Treasure has 6 ft. of 5% copper ore, and can supply 5 tons daily to smelter. Dugway Mining Co. can furnish 10 tons. Belcher claims are considered especially promising.

TINTIC.—Iron Blossom Con. Mining Co. reports for year ended November 30, 1917, ore sales worth $526,909 on company account and $67,854 from lessees. Operations cost $357,874. Dividends absorbed $250,000. Balance at beginning of year was $224,315, and ended with $148,995. Leasing has been adopted for most of the mine, on the following basis:

Value per ton	Royalty, per cent
Up to $10	20
$10 to $15	25
$15 to $20	30
$20 to $25	35
$25 to $30	40
$30 and up	50

WASHINGTON

CHEWELAH.—Northwest Magnesite Co. has suspended mining and calcining ore indefinitely. About 100 men will be out of work.

KETTLE FALLS.—Ark Mining & Milling Co. of British Columbia has been reorganized as the Ark Mines Co. of Washington to operate the Silver Queen claims three miles south of this place. J. J. Budd is president.

LOON LAKE.—Loon Lake Copper Co. has developed considerable ore to depth of 500 ft., and is to issue bonds for $40,000 to construct a mill, etc. Flotation and fine grinding machines are to be included. Profit in sight is estimated at $150,000. C. J. Stone is in charge.

OROVILLE.—Hudson Consolidated Mines Co., formerly Owasco, has made financial arrangement to erect 150-ton ball-mill and flotation plant costing $75,000. Ore-reserves said to be 50,000 tons of smelting grade, and 100,000 tons for the mill, latter to give $2 per ton profit. A. E. Wilson is in charge.

REPUBLIC.—Frank Babcock, of Ewan, has purchased the Belcher property here for $50,000, payable in instalments over a period of two years. Last year the Belcher shipped 3000 tons of low-grade copper-gold ore, carrying 6% copper and $1 in gold. Some 5000 ft. of development has been done.

WISCONSIN

PLATTEVILLE.—Better conditions prevailed in the zinc region in the first week of March. Although markets were dull, ore production improved, gross yield being 4525 tons, and net to smelters 2200 tons. Increased output, however, is not for ore-dressing plants, and a big reserve is on hand in the field. There has been a falling-off in shipment of high-grade product to smelters. Deliveries of low-grade ore have been slow, and reserves are piling-up. Stocks of lead ore are from 1500 to 2000 tons, only 5 carloads leaving the field during week ended March 5. Demand for pyrite improved. One concern is said to have over 5000 tons on hand. Hercules Mining Co., with capital of $100,000, has been organized at Cuba City to develop 400 acres on farms 2½ miles from that place. Drills cut high-grade zinc ore. Shaft is being sunk, and mill is to be erected in spring.

WYOMING

LANDER.—Asbestos in considerable quantity has been developed 25 miles south of this place by the American Fireproofing & Mining Co. Seams vary from knife-blade to 1½ in. thick. Two carloads were shipped some time ago. Lack of funds and facilities has hindered operations, according to the secretary, S. E. Collyer.

CANADA

ALBERTA

BANFF.—Silver-lead ore valued at from $148 to $182 per ton has been discovered in the Rockies near this place by Michael Penrose, who is employed by the Calgary Copper, Limited. The find is on the site of the deserted camp of Silver City, which,

30 years ago, had a population of 2000 people, most of them prospecting for this same silver vein. The ground now belongs to this company which was granted prospecting and mining rights before the order prohibiting prospecting in the Rocky Mountains Park was issued by the Dominion. This is the first discovery of galena of this kind in Alberta. Already 1000 sacks of ore are stacked at the mouth of the mine awaiting shipment, and the Calgary company is making arrangements for developing the property on a large scale.

British Columbia

Copper Mountain.—The Canada Copper Corporation is driving a tunnel to open ore at a depth of 1000 ft. below the highest outcrop. Work was started in October 1917, and on January 31 the opening was 2067 ft. long. Present advance is 18 ft. daily, including timbering. The tunnel will be connected with the upper workings by a raise 720 ft. long. The smelter at Greenwood is receiving 700 tons of ore daily. On account of coke shortage only one furnace is in blast.

Salmo.—Hudson Bay Zinc Co., on 300-ft. level, has opened ore 40 ft. wide. According to manager, M. W. Bacon, 400,000 tons should be developed.

Slocan Lake.—Eastern British Columbia mining companies are not experiencing any water shortage this year—an unusual condition. As a result, preparations have been made to resume milling at a number of properties. By the end of February nearly every plant near Slocan Lake will be in operation.

Ontario

Cobalt.—Wettlaufer-Lorrain Silver Mines reports for 1917 that from February 17, 1916, to September 1, 1917, the property was idle, since when the Pittsburg Lorrain Syndicate has been a lessee. No royalties were received. Surplus at end of 1916 was $129,152, and at end of 1917, $112,642.

Crown Reserve company may relinquish its interest in the Newray mine at Porcupine.

Nipissing Mines Co. produced in January silver valued at $307,019. Mills treated 6449 tons of ore, of which 53 tons was high grade. Shipments of bullion during January including custom metal were valued at $310,881. In December Nipissing produced silver valued at $340,793 and shipments totaled $376,433. No new veins were discovered in January. Diamond-drilling is under way in diabase in claim 407.

The Crown Reserve has installed a mining plant on the Walsh property in the Gowganda field, and is conducting extensive exploration. A number of promising veins has been discovered on the surface.

Ore from the Pittsburg-Lorrain mine, in South Lorrain, is being treated at the Wettlaufer mill, now under lease to the company. Cross-cutting on No. 3 and 4 levels is under way.

Sampling of the Hudson Bay has indicated the occurrence of a large quantity of low-grade ore, which, under present conditions, can be profitably treated.

The Mining Corporation of Canada is making good progress with the development of its gold claims in Rickard township. The mining plant has been erected and put in operation. A shaft is being sunk on the main vein, which has been uncovered for a distance of 500 feet.

Coniston.—Alexo nickel mine at Porquois Junction, 30 miles east of Porcupine, produced 812 tons of ore in January. This was a record output. Mond Nickel Co. treats the ore.

Kirkland Lake.—Companies in this district may have a geological examination made.

Mine managers and officials of Temiskaming & Northern Ontario railroad have conferred on the branch line to be constructed from Swastika to this goldfield.

KOREA

Unsan.—Oriental Consolidated in October treated 26,174 tons of ore yielding gold valued at $124,065, of which $47,790 was profit.

MEXICO

Chihuahua

Chihuahua.—Another effort will be made by the American Smelting & Refining Co. to operate its smelter at Chihuahua, according to advice received at Monterrey by officials of that company. It is stated that a large number of American employees recently assembled at El Paso for the purpose of proceeding to Chihuahua to re-open the plant. These men were provided with passports, but their crossing into Mexico has been delayed on account of a revival of bandit conditions immediately to the south of Chihuahua. It is planned, however, to send these men to Chihuahua soon, and it is expected that the smelter will be started early in March. It is stated that an ample supply of coke is on hand to keep the plant running for some time. Ore shipments from the Santa Eulalia and other districts of Chihuahua have been arriving at the smelter for several weeks past. It was the announced intention of the American Smelting & Refining Co. to also re-open its smelter at Velardeña, State of Durango, at the same time as the plant at Chihuahua, but disturbed conditions near Velardeña make that plan practically hopeless, for the present, at least.



NORTH-WEST AND CENTRAL MEXICO

Mines Company of America directors met in New York in January to consider re-opening its mines in Chihuahua and Sonora, but took no action.

Durango

Magistral.—Power-plant of National Mines & Smelters Co.,

was dynamited by Villistas on March 4. Two men were killed, but all Americans escaped.

MEXICO

MEXICO CITY.—Recent changes in export duty on ores and metals are of importance, according to a Consular Report to Washington, D. C. On December 13, 1917, it was decided to double export duties on gold and silver, thereby making rates 10% ad valorem on bullion, and 14% ad valorem on ores and concentrates, but these increases were apparently never put in force, as the monthly schedule of taxes for February 1918 shows about the same level as heretofore. On January 22, 1918, however, a decree was issued reducing to 1% ad valorem export duty on zinc in the form of ore, concentrate, or bars, the duty on other ores remaining 3% ad valorem. More recently duty on graphite has been reduced to 1.3% ad valorem. Reduction in duty on zinc was found necessary by reason of decrease in price in the United States. An order had previously been issued to facilitate exportation of zinc before the assay had been completed. By a decree of December 14, 1917, export duties were placed on iron and steel bars, wire, ingots, structural shapes, railway material, beams, and other forms, previously free of duty. At the same time, exportation of iron and steel manufactures, cables, pipe, and machinery was prohibited, except with the permission of the Treasury Department.

Bank of the Republic of Mexico with capital of $20,000,000 (U. S. currency), which, it is stated, will eventually be raised to $100,000,000, will open branch in Equitable building, New York, April 1. Under new Mexican currency system it will be only bank permitted to issue paper money, such money to be backed by gold reserves. Dr. Caturegli, American financial agent of Mexico, says statement that Mexico will borrow $15,000,000 gold is inaccurate. Arrangement provides for payment in gold of purchases of Mexican products, that is, silver, copper, oil, etc.

SONORA

DOUGLAS, ARIZONA.—Mineral exports from Mexico during January totaled 341 carloads, valued at $2,878,200, compared with 317 in December, valued at $2,785,000. Of the total of 13,347 tons, the Nacozari district contributed 11,286 tons; El Tigre, 219; Estrella, 782; Promontorio, 299; Archipelago, 104; Belen, 113; Bella Union, 89; and Ultima Chanza, 72 tons. The Jupiter, La Caridad, La Fortuna, San Julian, San Pablo, San Francisco, La Cruz, San Ignacio, Mexico, Las Chispas, Lillie, Santa Rosa, Cuicuila, La Reforma, and Esperanze shipped one car each, equal to 383 tons.

Shipments from Nacozari consisted mostly of copper-silver concentrate from the Moctezuma Copper Co., which were sent to the Copper Queen smelter at Douglas.

American Smelting & Refining Co. is operating three smelters in Mexico, namely, at Aguas Calientes, Matehuala, and Monterrey; but only at 35% capacity.

CANANEA.—This centre is busy, and a brief visit reveals the following situation:

Labor situation has been somewhat acute, owing to the large demand for men occasioned by resumption of work by Cananea Consolidated Copper Co., but conditions are rapidly becoming normal, and Mexican labor is flocking to the town.

Greene Cananea—Cananea Consolidated—is operating its smelter and rapidly getting its mines into shape for maximum production.

Democrata company, which has been operating regularly for past four years, is employing 900 men, and producing 900,000 lb. of copper per month. The new De La Vergne powerplant is ready for operation.

Calumet & Sonora company is operating its mine and mill and shipping zinc concentrate to the United States. This company is about to install a new Huff electrostatic plant for separation of zinc from copper ore.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

F. L. SIZER has returned from Merced, California.

GEORGE E. FARISH is here on his way to Salvador.

R. E. ADAMS has returned to El Paso, Texas, from Matehuala, Mexico.

D. C. JACKLING returned to San Francisco to be present at the flotation trial.

D. M. RIORDAN has gone to New York, expecting to return to San Francisco in April.

W. F. B. BEBGER, lately in Colorado, has an office in the Balboa Bdg., San Francisco.

H. HAMADA, chief metallurgist of the Kuhara Mining Co., of Japan, is in San Francisco.

R. B. YERXA, metallurgist to the Miami Copper Co., was present at the flotation appeal.

ALBERT BURCH is examining manganese supplies in the West Indies for the U. S. Bureau of Mines.

RICHARD L. GRIDER, of the University of Kansas, is at Rochester, Nevada, examining mines.

ALF. TELLAM and E. C. TEMPLETON have arrived from the Altai, Siberia, on their way to London.

F. E. BROWNE has been appointed to the U. S. Government Smokeless Plants, under D. C. Jackling.

POPE YEATMAN has been commissioned Lieutenant-Colonel in the Engineer Corps of the National Army.

L. B. HARRISON, superintendent of Monterrey smelter of A. S. & R. Co., Mexico, is now at San Antonio, Texas.

C. F. KELLY, vice-president of the Anaconda company, has been elected a director of the Inspiration Consolidated.

JAMES L. BRUCE, manager for Butte & Superior Mining Co., was in San Francisco this week and is now at Los Angeles.

N. BRUCE MACKELVIE, president of the Butte & Superior Mining Co., has been in attendance at the flotation trial in San Francisco.

J. G. DICKENSON, manager of the O'Brien mine, Cobalt, and Miller Lake O'Brien mines, Gowganda, Ontario, has returned to Cobalt from a six weeks visit to the company's properties in Arizona.

GUY C. RIDDELL has returned to New York, after having spent over a year with the Broken Hill Associated Smelters in Australia. He has been appointed special expert on metals by the U. S. Tariff Commission.

Nevada Mine Owners' Association at Reno has elected the following: J. W. HUTCHINSON of Goldfield, president; W. H. BLACKBURN of Tonopah, first vice-president; L. V. JENKINS of McGill, second vice-president; and HENRY M. RIVES, secretary.

W. S. BOYD, formerly superintendent of mines for Ray Consolidated, has been appointed assistant general manager, succeeded as mine superintendent by G. A. SMITH, formerly assistant, his former position in turn being taken by E. A. Thornton.

U. S. CIVIL SERVICE COMMISSION announces open competitive examinations for metallurgical chemists, salaries $1600 to $2400 per year, and assistants thereto at $1000 to $1600. Applicants should apply at once for Form 1312, stating the title of the examination desired, to the Commission at Washington. On account of the urgent needs of the service, applications will be received until further notice.

AMERICAN CHEMICAL SOCIETY has decided to omit its St. Louis meeting in April. The annual meeting will be held at Cleveland, Ohio, in September.

THE METAL MARKET



METAL PRICES

San Francisco, March 12

Aluminum-dust (100-lb lots), per pound	$1.00
Aluminum-dust (ton lots), per pound	$0.90
Antimony, cents per pound	15.50
Antimony (wholesale), cents per pound	13.60
Electrolytic copper, cents per pound, in carload lots	23.50
Electrolytic copper, cents per pound, in small quantities	24.67
Pig-lead, cents per pound	9.50
Platinum, soft and hard metal, respectively, per ounce	$108— 116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	9.50
Zinc-dust, cents per pound	17.50

Aluminum price has been fixed at a maximum base price of 32c. per lb. for lots of 50 tons and over of ingots, 98 to 99% grade. Price is subject to revision June 1.

ORE PRICES

San Francisco, March 12

Antimony, 45% metal, per unit	$1.10
Chrome, 34 to 40%, free SiO_2, limit 8%, f.o.b. California, per unit, according to grade	$0.60— 0.70
Chrome, 40% and over	$0.90— 1.05
Magnesite, crude, per ton	$8.00—10.00
Tungsten, 60% WO_3, per unit	$24.00
Molybdenite, per lb., 85% MoS_2	$2.15

Manganese prices quoted by the Miami Metals Co., South Chicago, Illinois, are as follows:

Manganese, %	Cents per unit
37 to 39	79
39 to 41	83
41 to 43	87
43 to 45	91
45 to 47	95
47 to 49	99
49 to 51	103
51 or over	107

These prices are f.o.b. cars South Chicago, and silica content must not exceed 15%. Penalty is 50c. per ton for each per cent silica over 8%, and bonus of 50c. for each under 8%. Settlement based on sample by Utah Ore Purchasing Co. at Murray, Utah.

Fluorspar is scarce at Eastern steel plants, on account of weather, labor, and transportation difficulties at the mines. The mineral is used as flux in basic open-hearth furnaces. Contracts for fluorspar in 1917 were $7 per ton at mines, but those for 1918 have been made at $25, with prompt delivery at present $38 per ton. Kentucky and Illinois produce most of the ore, but Colorado has good deposits, and some has been mined in Arizona.

Chrome in the East is firm, with business having been done at $1.50 per unit, delivered New Jersey, for a minimum of 43% Cr_2O_3.

EASTERN METAL MARKET

(By wire from New York)

March 12.—Copper is quiet. Lead is steady and firm. Spelter is dull and lower. No quotations for platinum.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Mch.	6	Jan. 29	23.50
"	7	Feb. 5	23.50
"	8	" 12	23.50
"	9	" 19	23.50
"	10 Sunday	" 26	23.50
"	11	Mch. 5	23.50
"	12	" 12	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	....	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Copper production of principal mines in February was as under:

Mine	Pounds	Mine	Pounds
Chino	5,882,581	Anaconda	24,100,000
Cerro de Pasco	5,332,000	Inspiration Con.	6,200,000
Nevada Con.	6,250,000	Miami	4,502,905
Ray Con.	6,860,000	Old Dominion	2,841,000
Utah Copper	11,900,000	East Butte	2,324,040

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Mch.	6	Jan. 29	87.35
"	7	Feb. 5	86.62
"	8	" 12	85.93
"	9	" 19	85.48
"	10 Sunday	" 26	85.30
"	11	Mch. 5	85.12
"	12	" 12	85.66

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04.	76.44	....	Dec.	75.70	85.97	....

Silver in London was dull at end of February, according to Samuel Montagu & Co. The Shanghai exchange was inclined to be steady. Indian currency returns showed a further decrease in silver holdings, and were the lowest since November 11, 1913. Stocks in Shanghai on February 16 were 28,900,000 oz. in bars and 13,000,000 Mexican dollars.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Mch.	6	Jan. 29	7.00
"	7	Feb. 5	7.00
"	8	" 12	7.00
"	9	" 19	7.08
"	10 Sunday	" 26	7.10
"	11	Mch. 5	7.33
"	12	" 12	7.25

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

Lead ore at Joplin is $87.50 per ton, basis 80% metal, up $2.50.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Mch.	6	Jan. 29	7.87
"	7	Feb. 5	7.87
"	8	" 12	8.00
"	9	" 19	8.00
"	10 Sunday	" 26	8.00
"	11	Mch. 5	7.91
"	12	" 12	7.79

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7 84	....

Zinc ore at Joplin is steady at $50 to $65 per ton, basis 60% metal.

Eagle-Picher Lead Co. of Joplin, Missouri, reports sale of 250 tons of grade C spelter to Navy Department at 7.90c. per pound.

Butte & Superior in February produced 6250 tons spelter, 250,000 oz. silver, and made a recovery of 95%.

Spelter stocks in United States are estimated at 70,000 tons, an increase of 10,000 tons compared with February 1.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Week ending	
Feb.	12	Feb. 26	115.00
"	19	Mch. 5	110.00
		" 12	115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	.....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	.....
Mch.	219.00	113.75	.....	Sept.	75.00	112.00	.....
Apr.	141.60	114.50	.....	Oct.	78.20	102.00	.....
May	90.00	104.00	.....	Nov.	79.50	102.50	.....
June	74.70	85.50	.....	Dec	80.00	117.42	.....

Quicksilver in London is quoted at £20 per flask, equal to $96.

Wah Chang Mining & Smelting Co., Ltd., a corporation of China, desires to announce that the exclusive right to sell antimony, tin, tungsten, zinc, lead, and other products of the Wah Chang Mining & Smelting Co., Ltd., in the United States has been given the Wah Chang Trading Corporation, a corporation of the State of New York. It is expected that this change will offer opportunities for even better service to its customers.

Eastern Metal Market

New York, March 6.

All markets are bare of important news or features, and are generally quiet.

Copper is still somewhat scarce, but production is increasing.

Tin is active for future delivery, but is unobtainable for spot.

Lead is fairly active and firm.

Zinc is lifeless and lower.

Antimony is practically unchanged and dull.

Aluminum has been regulated by the Government.

The principle topic in the steel market is the question of a revision of prices after April 1. A meeting of representatives of nearly 75 steel companies was held in New York this last week. It was shown in many cases that costs had advanced to such an extent as to make higher prices necessary, particularly as to plates. It is understood that this was not true of the U. S. Steel Corporation and some of the large independent companies. Cost-sheets are being prepared, and the matter will be discussed at Washington, probably during the third week of March. Pig-iron output in February was 5000 tons per day in excess of January, or 82,835 tons against 77,799 tons per day in January. It is not expected now that the 1918 output will equal that of 1917.

COPPER

Production figures for February are being watched with interest. Those so far reported show a higher relative output than in January, though this was under the same month a year ago. It is admitted that a scarcity, in this district at least, still exists, though it is not a serious one. It has caused some consumers anxiety recently, but reports are to the effect that no one has suffered. One large mill, which has both Government and other work, is really short of metal. The scarcity is a natural result of railroad congestion, severe winter, and other causes. Sales are being carefully regulated, the big buyer being, of course, the Government and its Allies. Producers are not inclined to commit themselves much beyond their present bookings until the situation is easier. All sales are made at the fixed prices of 23.50c. for wholesale and 24.67½c. for jobbing lots. February exports are estimated at 35,000 tons.

TIN

There is little to say about the tin market. It has been very quiet practically all of the past week, up to yesterday. On that day a fair business was done in futures, consisting of April and May shipments from the East, also in Banca tin. There is no average market quotation on these markets, each sale being a transaction by itself, subject to conditions pertaining to each case. There is no news as to permits or as to control of the market. As a whole the market is practically unchanged. Arrivals up to yesterday, March 5, inclusive, had been 385 tons, with the quantity afloat unreported. There has been but little change in the London market since last week. Yesterday the quotation for spot Straits was £319 5s. per ton, against £319 10s. a week ago.

LEAD

There are no special features. Considerable surprise can be detected in the trade over the Trust's advance in its price a week ago to 7.25c., New York, and satisfactory reasons are not given. It is generally conceded, however, that if the price should advance later to 7.50c. or above, the Government will step in and control the market as in copper. The market has been fairly active during the past week. Inquiry has been good and business has been done at 7.25c., New York, for shipment from the West. Lead for spot shipment has brought 7.50 to 7.75c., New York. All shipments from the West are subject to embargoes, and the buyer must assume the burden in each case. It is up to him to obtain permits.

ZINC

It seems to be impossible for the zinc market to show any signs of life. It has been more or less half dead for the greater part of a year. Production has been growing steadily less, but there still seems to be plenty of zinc to meet the demand, which is really light in proportion to the output. The market during the past week has grown weaker if anything, and prime Western is quoted at 7.62½c., St. Louis, and 7.87½c., New York, for early or March delivery. This has been shaded to 7.60c., St. Louis, on small sales, and it is stated that 7.50c., St. Louis, can be done. The 500 tons of grade C for the Government, referred to in last week's letter, has been awarded at 7.90c., New York basis. Spot zinc, prime Western grade, has sold as high as 8.25c., New York, in the last few days, but not in large quantities. Though considerable is held in New York for export, metal for spot delivery is scarce just now as the result of the railroad congestion. Grade A is quoted at 15c. per pound.

Sheet-zinc is available at the Government price of 15c. per pound, base, but it is a fact that the new list of extras calls for double the extra prices that obtained previously.

ANTIMONY

The market is unchanged at 13.50c., New York, duty paid, for Chinese and Japanese grades for prompt and early delivery, despite the fact that two 25-ton lots recently went at 13.25c., New York. No more seems to be available under 13.50 cents.

ALUMINUM

A fixed price of 32c. per pound has been placed on No. 1 virgin metal, 98 to 99% pure, by agreement between the War Industries Board and the producers. This contrasts with a previous price of 36 to 39c. which has prevailed for some time. The new price is to stand until June 1 and applies to nothing less than 50-ton lots. The status of smaller quantities remains unsettled.

ORES

Antimony: No developments are noted in the market.

Manganese: A new high record has been made in sales of manganese. A lot of high-grade Indian ore went to a large maker of ferro-manganese this week at $1.35 per unit; the previous high was $1.30 for this or any other ore. When the writer of these notes questioned about its making the alloy, an official of the Anaconda Copper Mining Co. in New York stated that there was nothing to be said about it at present.

Molybdenite: This is slightly lower at $2.10 to $2.15 per pound of MOS_2 in 85 to 90% concentrate. This is nominal, demand having been light.

Tungsten: Business is difficult, due to shipping embargoes, and prices are unchanged at $20 to $26 per unit, depending on grades with demand quiet. One dealer reports the placing of a large contract for wolframite at $24 per unit in 60% concentrate. Ferro-tungsten is unchanged at $2.25 to $2.35 per pound of contained tungsten.

COPPER PRODUCTION of nine of the leading American mines—Anaconda, Chino, Inspiration, Miami, Nevada, Old Dominion, Phelps-Dodge, Ray, and Utah—for the first two months of 1918 total 173,707,000 lb., against 187,355,000 lb. in this period of 1917. Reduction is due to Inspiration not being up to capacity since the strike.

Company Reports

ST. JOSEPH LEAD CO.

PROPERTY: lead mines in south-east Missouri, producing over 8000 tons of ore daily.

OPERATING OFFICIALS: C. J. Adam, general manager at mines; W. A. Smith, manager of Herculaneum smelter.

FINANCIAL STATEMENT:

	1917	1916	1915	1914
Income	$10,130,459	$8,004,649	$4,392,360	$2,427,686
Depletion, etc.	4,520,186	3,330,182	.....	.....
Charges	.....	.....	902,396	880,411
Balance	*5,610,273	4,674,467	3,489,964	1,547,275
Dividends	3,535,531	1,409,466	854,980	258,391
Surplus	2,074,742	3,265,001	2,634,984	1,288,884

*Equal to $3.98 per share on $14,094,660 stock ($10 par), compared with $3.31 in 1916.

UNITED VERDE COPPER CO.

PROPERTY: copper mine at Jerome, Yavapai county, Arizona.

OPERATING OFFICIALS: C. W. Clark, general manager; R. E. Tally, assistant; T. Taylor, smelter superintendent; C. V. Hopkins, chief engineer.

FINANCIAL STATEMENT: revenue from metal sold was $15,319,445. Investment account stands at $12,339,503, a gain of $4,934,981. Cash at end of 1917 amounted to $1,958,528, against $1,771,961 a year ago.

DIVIDENDS: in 1917 were $17.25 per share, equal to $5,175,000, against $13.50 in 1916, $6 in 1915, $3.75 in 1914, and $5.25 in 1913.

PRODUCTION:

	Copper, lb.	Silver, oz.	Gold, oz.
1917	71,726,634	1,223,311	29,230
1916	58,299,573	1,030,850	26,416
1915	45,127,832	902,880	28,221
1914	32,449,116	646,285	21,393
1913	35,333,924	641,626	20,664
1912	31,565,539	484,222	15,082
1911	33,166,987	461,145	15,239

Sales were 51,664,098 lb. copper at 27.302c. per lb., 875,451 oz. silver at 80.366c. per oz., and 22,235 oz. gold at $20.50 per oz. Remainder of the metal was carried in inventory, a new system for this company.

BRUNSWICK CONSOLIDATED GOLD MINING CO.

PROPERTY: gold mine near Grass Valley, California. In 1917, 440 acres adjoining were acquired, through which the Brunswick vein extends.

OPERATING OFFICIALS: R. Chester Turner, general manager; C. H. Mallen, superintendent.

FINANCIAL STATEMENT: during year ended January 24, 1918, revenue from bullion and concentrate totaled $182,867. Balance from previous period was $50,587. Including sundries, total revenue was $239,185. Expenditure amounted to $207,729, and balance carried forward was $31,356.

DIVIDENDS: none was paid in 1917, and total remains at $203,315, equal to 51c. per share. Assessments to date amount to $1.22 per share.

DEVELOPMENT: all work covered 1896 ft. in 1917, the new shaft being sunk 74 ft. This shaft was sunk to 1347 ft., cost being $68.06 per foot in 1917. On 1300-ft. level gold is unevenly distributed in the east drift. At 1100 ft. the shoot is 700 ft. long, but stopes over the western 300 ft. of this level extended only half way to 1000 ft., where the ore was of no value. Most important development was discovery of good ore in the 1100-ft. south cross-cut, being driven to prospect the Matteson Ranch ground. A new electric hoist is needed for deeper work. Reserves are estimated at 10,000 tons.

PRODUCTION: two stamp-mills crushed 30,805 tons of $6.547 ore, yielding $4.965 per ton by amalgamation and 95.9c. by concentration, a total of $5.924 per ton, equal to a recovery of 75.8 and 14.6% respectively. Total since 1893 is $1,765,361.

COSTS: including operating and administration charges, totaled $6.2616 per ton. Mining accounted for $4.3171, milling, 91.03c.; new shaft, 16.35c.; repairs, 6.92c.; improvements, 13.29c.; and general, 66.66 cents.

CHIEF CONSOLIDATED MINING CO.

PROPERTY: lead-zinc-gold-silver claims at Eureka, Utah.

OPERATING OFFICIALS: Walter Fitch, general manager; Cecil Fitch, superintendent.

FINANCIAL STATEMENT: during year ended December 31, 1917, ore sales realized $1,554,714. Balance on hand was $477,295. Total receipts, including sundries, were $2,057,841. Expenses were $1,127,316 for operation, $134,618 for new property, and $43,682 for equipment. With $159,000 of Liberty Bonds, disbursements were $1,385,995. Balance forward to 1918 is $262,394.

DIVIDENDS: four paid in 1917 totaled $309,452, making $925,392 to date.

DEVELOPMENT: new openings totaled 20,276 ft. Between the 600 and 1850-ft. levels, work included development of existing orebodies and searching for others, commonly found in association. Below 1800 ft. is under water-level, and ore mined is rich. New ore-channel on this level steadily yielded lead-carbonate ore. Production in 1917 was principally from 700, 800, 1600, and 1800 feet.

PRODUCTION: shipments amounted to 59,950 tons, averaging 0.153 oz. gold, 25.6 oz. silver, 14.84% lead (11.92% in lead ore), and 20.29% zinc (36.16% in zinc ore). Gross value was $40.12 per ton. Metal contents were 9175 oz. gold, 1,534,907 oz. silver, 10,846,710 lb. lead, and 690,747 lb. zinc.

COSTS: were $18.80 per ton at the mine, and $14.19 for freight, sampling, and smelting, a total of $32.99. Deducting this from gross value, net profit was $7.13 per ton.

UNITED VERDE EXTENSION MINING CO.

PROPERTY: copper mine at Jerome, Yavapai county, Arizona.

OPERATING OFFICIALS: George Kingdon, general manager; H. DeWitt Smith, superintendent.

FINANCIAL STATEMENT: past two years compare as follows:

	1917	1916
Gross sales of metal	$14,583,649	$9,949,919
Other revenue	171,465	31,154
Total	$14,755,144	$9,981,073
Expenditures, taxes, etc.	6,496,997	3,042,872
Dividends	1,680,000	1,050,000
Surplus	6,578,147	5,888,101

DEVELOPMENT: openings totaled 12,266 ft., largely in connection with new shaft and adit. No new orebody was found. Reserves compare as follows:

	1917	1916
Ore, tons	885,000	1,000,000
Copper, per cent	14.5	16.0
PRODUCTION:		
Ore, tons	115,064	80,159
Copper, per cent	27.0	22.7
Silver, ounces	2.89	1.60
Gold, cents per ton	29	64
Copper sold, pounds	58,239,636	36,402,972
Average price, cents	27.034	.....
Copper on hand, pounds	20,860,622	.....
Cost per ton of ore	$32.880	$29.910
Cost per pound of copper	0.058	0.066

Recent Decisions

PLACER CLAIM—KNOWN LODES

Conveyance of a placer claim, under United States Revised Statutes Section 2320, includes all known veins and lodes of quartz within the boundaries of the claim.

Wilbur *v.* Everhardy (California), 167 Pacific, 861. September 17, 1917.

DUMPING TAILINGS ON ANOTHER'S LAND—LIABILITY

Where the managers in charge of the mining operations of a corporation, with knowledge of plaintiff's objections thereto, dumped tailings on plaintiff's land, they, as well as the corporation, were liable for damages.

Robinson *v.* Moark-Nemo. Consol. Min. Co. (Missouri), 196 South-Western, 1131. July 2, 1917.

SEVERANCE OF MINERALS—ADVERSE POSSESSION

Oil and gas are included as minerals in a reservation of "all mineral rights" in a deed. Where mineral rights have been severed by deed a possessor of the surface for agricultural purposes can acquire no adverse possession of mineral rights.

Barker *v.* Campbell-Ratcliff Land Co. (Oklahoma), 167 Pacific, 468. September 18, 1917.

COAL MINE—LIABILITY OF SURFACE OWNER FOR DAMAGE

The owner of the surface of coal lands, the mineral rights to which are owned by another, is liable for damages to that other for making openings in a stream bed which permitted water and sewage to flow into the mine being operated by the other beneath the lands in question for the extraction of coal therefrom.

Sorg *v.* Frederick (Pennsylvania), 100 Atlantic, 481.

OIL LEASE—VALIDITY OF EXTENSIONS

When a landowner execute an oil and gas lease and later grants two extensions thereon, and while the latter of these two extensions is in full force and effect executes a second lease on the property, the second lessee, if he has actual or constructive knowledge of the extensions of the first lease, acquires no rights under the second one.

Swan *v.* O'Bar (Oklahoma), 167 Pacific, 420. September 18, 1917.

MINING OPTION—STOCKHOLDERS' CONSPIRACY

A mining company having entered into an option agreement for the purchase of mining claims in Arizona, had difficulty in meeting payments under the option. Thereupon certain stockholders in the company secretly bought up the optionor's title and later entered into a re-organization plan with creditors. Held, no conspiracy to defraud was shown by the above acts of the stockholders, nor could the price fixed in the option contract be taken as any indication of the cash value of the property, since the only obligation upon the optionee was to forfeit payments already made if it desired to abandon the agreement.

Munro *v.* Smith (Rhode Island), 243 Federal, 654. July 13, 1917.

OIL LEASE—FORFEITURE DENIED

Where three persons execute an oil lease jointly, it cannot be forfeited upon a notice signed by but two of them. Where the lease requires such a notice to include an alternative demand for performance of conditions of which a breach is claimed, a notice to the lessee not containing such alternative demand is fatally defective. Where the lease also requires performance of assessment work on each claim prior to September 1 of each year, or forfeiture as to those claims upon which such work is not performed, the lease will not be forfeited as to claims for which patents were secured by the lessee because of non-performance of annual labor on the unpatented claims.

Jameson v. Chanslor-Canfield Midway Oil Co. (California), 167 Pacific, 369. September 27, 1917.

MINING TRESPASS—PLAINTIFF'S POSSESSION

An action of trespass for the unlawful mining of coal could not be maintained where the plaintiff had never been in the actual or constructive possession of the surface which was in possession of parties holding adversely, and under whose lease defendant had removed the underlying coal, as plaintiffs, never having severed the coal, were not in constructive possession thereof.

Griffin *v.* Delaware & Hudson Co. (Pennsylvania), 101 Atlantic, 750.

Book Review

A TEXTBOOK OF INORGANIC CHEMISTRY. Edited by J. Newton Friend. Vol. IV. Aluminum and Its Congeners, Including Rare Earth Metals, by H. F. V. Little. Plates. Ill. Pp. 485. Name and subject-indexes. J. B. Lippincott Co., Philadelphia, 1917. For sale by MINING AND SCIENTIFIC PRESS. Price, $5.

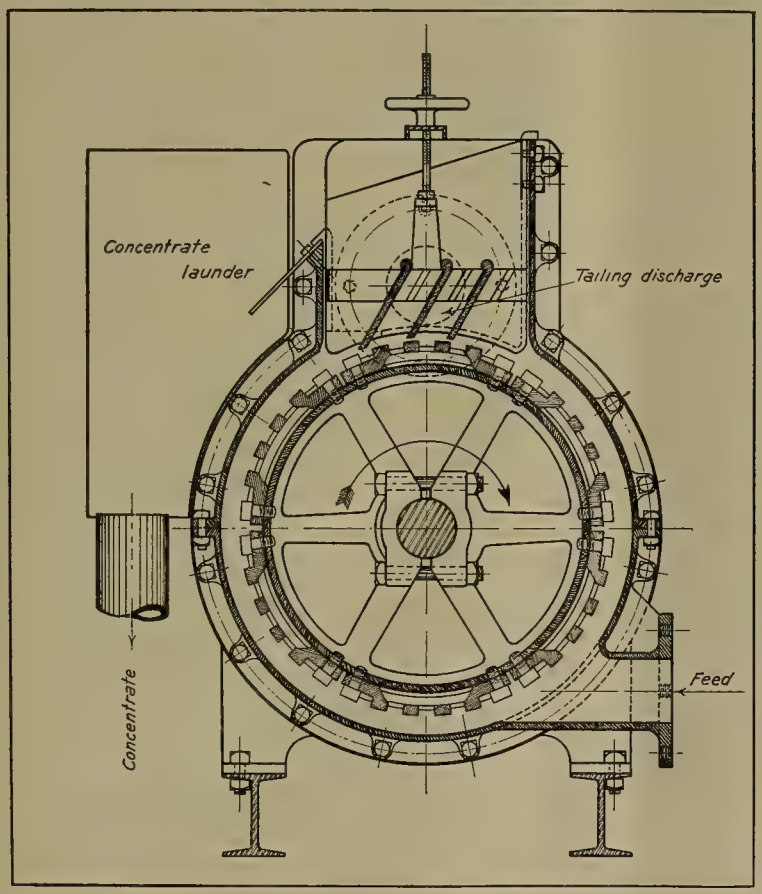
This is the third volume, issued to date, of the notable series of textbooks on inorganic chemistry constituting one of Griffin's scientific series. The scheme for a consistent orderly discussion of the subject was evolved by the editor, Dr. Friend, and assignments to specialists were then made. The authors have varied in their rapidity of work, so that the next to the last of the series, Vol. VIII, was issued first, this being in 1915. It dealt with the halogens and their allies, and was prepared by Jeffry Martin, and E. A. Dancaster. It is one of the most satisfactory treatises on the halogens that has yet appeared, and is interesting and valuable for study as well as for use as a handbook. Vol. I, which is an introduction to modern inorganic chemistry by J. Newton Friend, H. F. V. Little, and W. E. S. Turner, is an admirable resume of the fundamental principles of chemistry, and is unexcelled as a reference book on the fundamentals of the science. It also deals with the chemistry of helium, neon, argon, krypton, xenon, and niton. It is thoroughly up-to-date in every particular, and the exposition is strikingly lucid and will be appreciated by students. Vol. III, which has now come to hand, also published in 1917, is particularly timely on account of its discussion of aluminum and the relations of this element to modern industry in the production of the metal, and in ceramics. There is also an interesting chapter on the production of ultramarine, which discusses the technique of the subject. In view of the interest in rare metals it is necessary to call attention to the fact that this volume deals with the rare-earth elements, and not with the rarer metals that have recently been arousing so much popular interest in connection with alloys. The elements discussed are gallium, indium, thalium, scandium, cerium, lanthanium, praseodymium, neodymium, samarium, europium, gadolinium, turbium, the yttrium group, and actinium and its disintegration products. The general characteristics, thermochemical properties, and general reactions of all of these metals are given in great detail, and the conditions under which the various salts and acids may be obtained are given with sufficient clearness so that any chemist would be able to obtain satisfactory results. It should also be mentioned that one chapter deals with boron, and that a discussion of the relations of the rare earth metals in the periodic series is given in the form of an introduction. These volumes should constitute part of every chemist's library.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

KRAUT FLOTATION MACHINE

This is an improvement on the well-known 'K & K' flotation machine, which has been on the market for about a year. In that short length of time it has gained a remarkable popularity. The principle employed in this latest type of machine is identical with that in use in the original 'K & K' apparatus, retaining the rotor, consisting essentially of a hollow cylinder, the surface of which is provided with longitudinal riffles and air-spaces between them, through which the air is introduced into the pulp from the atmosphere, this entering as a result of the reduction in static pressure caused by the velocity or motion of a relatively thin layer of pulp adhering to and following the surface of the rotating cylinder. The air is entrapped between the riffles, and a thin film of pulp is drawn over it, causing the formation of bubbles to which the mineral particles adhere.



IMPROVED K & K FLOTATION MACHINE

The essential feature that differentiates this new apparatus from the older type, consists in the fact that it dispenses with the spitzkasten in front of the machine. Instead, there is a bubble-collecting chamber arranged on top, and a series of adjustable skimmers, as shown in the accompanying illustration. By means of these skimmers the bubbles carrying the mineral particles are removed from the rotating pulp almost as fast as they are made, collected in the collecting-chamber until there is a sufficient quantity to fill it to the top, and then made to overflow a discharge lip into a concentrate launder. The pulp entering at the bottom, at one end of the machine, is being rotated continually by the rotor, moving in a helical path toward the tailing-end of the machine, where it is finally discharged at the top of the machine after having surrendered its mineral contents.

The advantage over the previous types of K & K machines consists in the increased efficiency, combined with the reduced floor-space, which is about half that required by the older type, and, further, in the fact that no head-room is lost. On the contrary, head-room is gained, the tailing-discharge being 18 in. above the feed-intake. This renders it possible, when desired, to pass the tailing from one to another machine for re-treatment on the same floor-level. In operation, a distinguishing feature of this apparatus as compared with other flotation machines is, that there is no pulp-level, but at the point of contact with the skimmers there is a mixed zone of mineral carrying bubbles and pulp. As there is no pulp-level to be maintained, no regulation of such a pulp-level is necessary, and therefore it does away with any need of adjustment for accomplishing this object. A simple device at the tailing-end of the machine regulates the tailing-discharge automatically in such a way that it always equals the feed-intake in volume. Another adjustment makes it possible to control the amount of pulp held in the machine at any one time.

The entire mechanism will be built of steel and cast-iron, and will be placed on the market in a short time by the Southwestern Engineering Co. of Los Angeles.

FLAT WALL-PAINTS now in popular use are composed of non-poisonous pigments and produce a water-proof surface which permits of washing, is impervious to dampness, and resists decay. On their hard non-absorbent surface there is not the slightest foothold for dust or germs. Through the use of flat wall-paints for interior decoration every surface in the home—floors, walls, and ceilings—may be fully exposed to the purify-

ing effects of light, air, and sunshine. For kitchens and baths sanitary gloss paint is preferable, as it is even more easily cleaned. Paints are not only sanitary, but they are in themselves powerful disinfectants. Drying paints give off vapors containing formaldehyde, an antiseptic which is fatal to bacteria. In fact, painting is one of the most efficient means of destroying bacteria in rooms previously occupied by persons with contagious diseases. If the windows are kept closed for a short time after the painting is finished, every portion of the walls and ceiling, and the contents of the room, will be fumigated or disinfected. Government tests of painted and papered surfaces exposed to the same conditions have shown an enormous development of bacteria in wall paper, while the washings from the painted surface showed a practical absence of bacteria. From the standpoint of economy the flat wall-paints should appeal especially to the home owner. Their low cost, their abality to hide surfaces with a few coats, and their large spreading capacity, mean a great saving in first cost, while their exceptional wearing qualities ensure long and economical service. They flow on easily, without showing laps or brush marks. The general adoption of flat finishes in hospitals, hotels, and public buildings to secure effects and sanitation suggests use of these in the home.—'Du Pont Magazine.'

HELP TRANSPORTATION

The growing difficulties of freight transportation has induced the Associated Business Papers, Inc., New York, through their executive committee, to formulate a plan for definite practical co-operation by shippers to relieve terminal congestion and to keep freight moving. Neither the efficient control of Government bodies, nor the wisdom of the railroad men can solve the whole problem. A large part of the trouble is the local and short-haul difficulty, resting in congestion which extends back into the main arteries of transportation. Business men in all lines of endeavor should realize that they are not merely buyers of transportation, at a price per mile or per ton, but that adequate transportation service is absolutely necessary to the profits of business. At the present time interest charges on goods in transit frequently amount to more than double the cost of the transportation, while the cost of waste, due to inability to secure materials and to ship goods, runs into larger figures.

The Government having now assumed control of the railroads, and Director General McAdoo having surrounded himself with a staff of practical railroad operators; a National Highway Committee having been appointed with Roy D. Chapin, president of the Hudson Motor Car Co., as its head, with the Board of National Waterways Association working with the official committee on this problem, it is our recommendation that the matter will be best served by full co-operation with these governmental bodies. It is time to quit kicking about rules established to clear the tangle, and to co-operate in a whole-hearted and intelligent way.

It is recommended that the shipper should be urged to foster the following:

For Improvement of Railroad Service

(1) The provision of adequate rules to secure full efficiency.

(2) To establish proper charges for freight and demurrage and enforce equitable rules for loading and unloading, shipping and packing.

For Highways

(1) Extension of paved highways.

(2) Provision for keeping them open at all seasons.

(3) Proper provision for their maintenance.

For Waterways

(1) Construction of barges and small tow-boats to provide for the adequate use of existing highways.

(2) Provision for putting into shape existing waterways that had been allowed to become obsolete.

(3) Provision for the extension of these waterways to correlate with the railroad system.

Assisting the Railroads

(1) Co-operate without hesitation; do not object to changes.

(2) Load and unload promptly; do not wait for a convenient season.

(3) Load to capacity.

(4) Do not re-consign en route; decide upon the destination before the goods leave.

(5) Pack securely and mark plainly.

Aiding the Highways

(1) Make a survey of all incoming and outgoing freight handled within zones 10, 25, 50, or 75 miles from your city.

(2) Ship all goods to be delivered within the above zones over the road by motor-trucks.

(3) Demand that all goods to be shipped to merchants in your city, and originating within the zones mentioned, be delivered by motor-trucks.

(4) Make a census of all motor-trucks in your town available for this work.

(5) Take up with your local offices of the national express companies and your local haulage and express concerns as to how far they can extend their present delivery routes.

(6) Select a committee of the best traffic managers of concerns in your city to lay out a detailed plan to suit your local conditions, and determine upon fair rates to be charged.

(7) Arrange for a sufficient number of receiving platforms or warehouses where you can use horse wagons and motor-trucks up to 3-ton capacity to deliver and set down goods, leaving for the larger trucks the running between the main points in the zones. Do not try to make the trucks running overland between the main points do pick-ups and deliveries. It cuts down their efficiency and makes the maintenance of schedules impossible.

(8) Put some trucks in the overland-haul work on definite leaving schedules so that goods can be delivered to the receiving platforms or warehouses in time to make up full loads to any given points.

(9) Arrange a Return Loads Bureau. Arrange with the local telephone companies to give your regular telephone number to any inquirer asking for the Return Loads Bureau. Post notices in the offices of your merchants that you have established a Return Loads Bureau. Post similar notices in conspicuous places in the smaller towns and cities through which trucks, running to or from your city, will have to pass. This will enable your trucks, and those of private truck contractors, to quickly collect loads.

(10) Bring pressure to bear upon your mayor and the governor, and then to your highway commissioners, to keep the main highways leading out of your city open during the remaining winter months.

(11) Bring pressure to bear on the proper authorities to resume construction of main-line highways at the earliest possible moment this spring, and to maintain the roads throughout the year.

Promoting Waterway Efficiency

(1) Secure information upon transportation facilties on existing waterways covering short hauls.

(2) Urge the movement for immediate production of barges for large canals to relieve the freight congestion.

(3) Take up with the traffic manager of your business, and the traffic expert of the local chamber of commerce, the possibility of the use of waterways for any part of your freight movement, and arrange shipping plans accordingly.

N. L. Heinz of Pittsburgh is designing and building a sheet-zinc rolling-mill for American Zinc Products Co. at Greencastle, Indiana.

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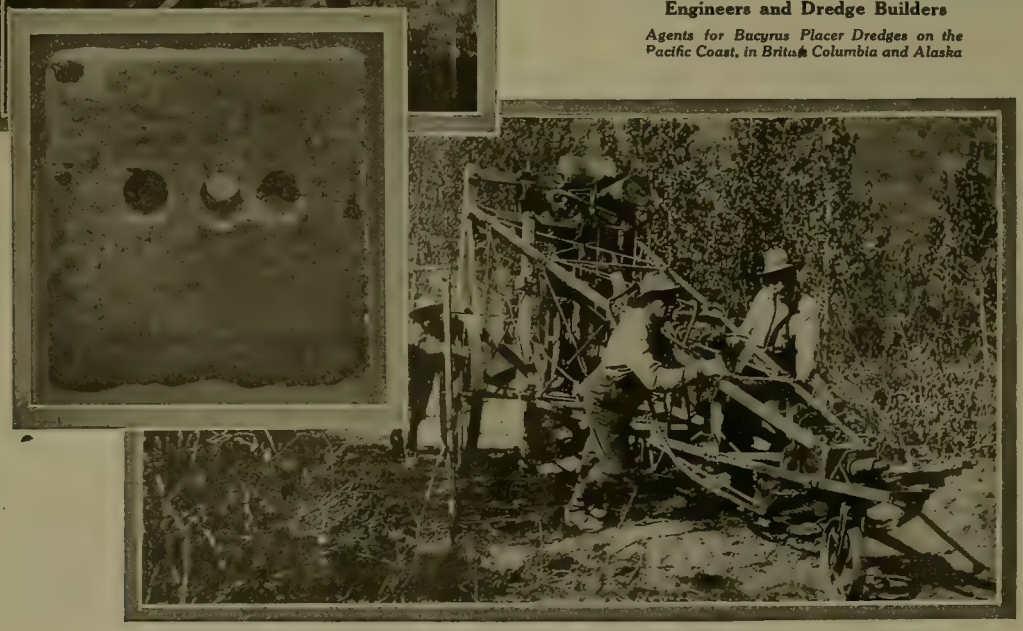
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WE take pleasure in publishing an article on the fixation of the price of silver by two representative mining engineers, Messrs. Emmet D. Boyle and Whitman Symmes. The senior author is Governor of the State of Nevada, the junior is superintendent of the Union Consolidated and other important mines on the Comstock; both were members of the committee of Western men that went to Washington recently to consult with the Department of the Interior in regard to the very question that they discuss in the article.

OWING to the exigencies of the War the British government has placed an embargo on the use of telegraphic codes. Among these is the code-book of the late Bedford McNeill, our friend and the friend of engineers all over the world. Mrs. McNeill writes to us asking for help in preserving the goodwill of her husband's life-work, and we are glad therefore to make a plea on her behalf to the profession, asking them to keep the code in mind and to use it whenever practicable, both because it is particularly serviceable for its avowed commercial purpose and because it perpetuates the memory of one of the kindest, most loyal-hearted, and most intelligent members of our profession.

NOT the least interesting feature of the recent flotation appeal in San Francisco was the opportunity given for ignorant sensationalism on the part of the daily press. For several days before the hearing our local newspapers had a lot to say about the '$60,000,000 suit' and 'The Big Fight of the Jackling Interests.' Most of their statements were grossly inaccurate, of course, but when the hearing actually took place not a single reporter was present in the court-room. That, however, did not prevent the newspapers from publishing a description of the proceedings. These descriptions were the "delirious trimmings"—as the old lady phrased it—of journalism. The 'Evening Howl' stated that "a huge working model of the disputed patent had been set up, and the crowded room reeked with acid fumes and other odors incidental to the operation of mining machinery." The laboratory machines in the room were not touched until four days later and no experiments of any kind were made during the hearing. The same scribe asserted that the argument, set for one day, was to "consume several days before a final decision can be handed down by the judges." The 'Morning Scream' reported that Mr. Williams "brought the gangue into Court for the first time during the session. The gangue is the soil and other non-valuable substances in the mixture of water and ore." The 'gangue' is also a group of ignorant young men that fabricate yarns that would disgrace a school-boy. Not one of the four papers gave the names of the three judges correctly. They all agreed in including Judge Gilbert, whose withdrawal from the hearing was significant. The treatment given by an irresponsible and ignorant press to an event so important and interesting is a striking example of inept journalism, the kind that flourishes under such men as De Young and Hearst.

THE Edisonian method of seeking a solution to a problem is to try everything. For example, when testing metallic salts in an effort to improve the storage battery, he set a corps of chemists to work experimenting with every salt that could be produced economically. Applying this all-inclusive method to the study of flotation likewise may disclose unexpected possibilities. A suggestive illustration is afforded by the results obtained by different experimenters working with alkaline chlorides. Messrs. M. H. Thornberry and H. T. Mann conducted an elaborate investigation at the Missouri School of Mines, employing a long list of chlorides, the results of which have just been published in 'Metallurgical & Chemical Engineering'. Their conclusion was distinctly unfavorable. With common salt the average extraction was 4% lower than without the addition of the reagent, but they followed the usual practice in using oils. Thus the fact was established that metallic chlorides with oils reduced the percentage of recovery, and yielded a leaner concentrate. Independently an experimenter in British Columbia, working close to the sea, and desiring, if possible, to employ sea-water in practical operation, made the discovery that the sea-water alone, without oil, was an efficient flotation agent. His remarkable results were published in our issue of February 2. Following the hint given by sea-water he tried simple solutions of sodium and magnesium chlorides. The common-salt solution, applied to an ore assaying 1.75% copper, yielded a concentrate containing 15.35% copper and left a residue impoverished to 0.07% copper. Plain sea-water, on the

same ore, gave a concentrate assaying 21.61% copper, and a tailing that held only 0.09%. These interesting tests reveal the importance of investigating every possibility, and of ascertaining the effects that may be produced by varying the conditions as well.

AMUSEMENT may be gained from the capitulation of business men, even of men of big business, to the man trained in the principles of business. The principles of business are known in academic circles as economics, and the business man has been accustomed to laugh at this science as 'theory,' just as a certain class of men, still cherishing the traditions of empiricism, have delighted in scoffing at the trained engineer and geologist. It has taken many years to win acknowledgment that the trained engineer has the advantage of working intelligently and taking the shorter cuts to obtain results through applying principles induced from multitudinous observations collected during the course of generations, while the 'rough-neck' blunders as soon as he exceeds the limits of safety that are defined by the scanty teachings of his individual experience. The business man is prone to assume lordly airs of superiority, because be makes a specialty of acquiring money, which gives him power, but the specialist, in the long run, surpasses the amateur in practical performance. The economist, for example, Mr. Irving Fisher of Yale University, would probably make as much money as Mr. Louis F. Swift, of meat-packing fame, should he devote his time and talent to it, and he would probably do it with less irritation to the sense of justice that rises perenially in the workingmen and in the general public despite their long habituation to commercial spoliation. Dr. Fisher, however, is too busy doing better things than the amassing of millions to be lured from his desk. Nevertheless, it is in no spirit of disparagement that we record the appointment, on a substantial salary, of Professor L. H. D. Weld, also of the Department of Economics at Yale, as economic advisor to Swift & Company as soon as it was noised abroad that Mr. Herbert C. Hoover would pay special attention to the economic side of food control and production. This recognition of merit was two-fold: first of all it showed a realization that the mining engineer, trained to do things scientifically, would apply scientific methods in the food administration, and in the second place it was a confession that the business man was weak on the side of the scientific direction of commerce; as long as it was a case of ruthless destruction of weaker competitors, of squeezing exorbitant profits from the public, and of hammering down the cost of labor, the academician could add no strength to his armor, but he needed help in dealing with a man who threatened to regulate industry in accordance with fundamental principles of right and justice. Notwithstanding this precaution, the packers seem to have blundered. The client that does not disclose everything to his attorney is apt to lose his case. The packers surreptitiously tried to defeat the operation of the new system while employing a scientific economist to adjust them outwardly to its requirements.

IN the article on the Komspelter region appearing in our issue of March 2 were two errors that would be detected by a careful reader. In estimating the number of acres to be exhausted in order to produce a given tonnage the words "per annum" were introduced by that little devil of perversity that sits on the index finger of typist or compositor—or author. "Per annum," like the flowers in the spring, "had nothing to do with the case." The other error was the omission of a zero. Obviously, if 200 acres were sold by Mr. McConnell for $200,000, then the rate was $1000—not $100—per acre. Referring to the Indians and their relation to the local mining industry, we are glad to add a further note. Prior to the passage of the Act of Congress of March 2, 1895, the Quapaws in Ottawa county, Oklahoma, held 100,000 acres of land as a 'reservation.' Pursuant to the Act just mentioned 300 Indians were allotted their lands in severalty, each Indian receiving 240 acres, the remainder of the tract being sold and the proceeds divided among the members of the tribe. A few Indians belonging to other tribes received allotments, as did also a number of white men that had been adopted into the Quapaw tribe. By the terms of the Act these Indians received their lands in fee simple, with a restriction upon alienation for a period of 25 years. In accordance with the General Allotment Act of 1887, and later by an enactment made in 1890, all Indians that received lands by allotment became citizens of the United States. The Quapaws could not lease their lands prior to 1897, at which time Congress gave them the right to do so without supervision or control of any kind for a period of three years if for agricultural purposes and for ten years if for mining purposes, but it was provided that if, by reason of age or incompetence, the Indian allottee was unable to manage his land, then the Secretary of the Interior, through the resident Agent, might lease it for him. This is the only supervision that the Government retains over the land holdings of the Indians, but the Quapaws cannot sell their lands without the Government's consent. The Indian agent is Mr. Ira C. Deaver, who lives at Wyandotte, where the Government conducts a free Indian school for the Quapaws and for six other small tribes that have been allotted lands in Ottawa and Delaware counties. The Government, through this Agent, exercises no control over these Indians personally, nor over their property, except as to the restricted Indian lands. Only one-tenth of the Quapaws have been declared incompetent; the others transact their own business and lease their lands as they see fit. The restrictions upon allotted lands will expire in 1921, but the Government reserves the right to extend the period of restriction, if it believe any of the Indians to be incompetent. It is pleasant to note the participation of our aboriginal citizens in the profitable exploitation of at least a part of our mineral resources and to record the act of justice by which this has been accomplished.

The Flotation Appeal

In our last issue we described the hearing before the Court of Appeals in the case of Minerals Separation v. Butte & Superior. The argument lasted one day and immediately afterward Judge Ross returned to Los Angeles, so that the subsequent proceedings did not take place technically before the Court. It appears, however, that the two other judges, who, unlike Judge Ross, did not sit in the Hyde case, and to whom the technology of the flotation process was new, expressed a wish to see the moving-picture demonstration that the Minerals Separation experts had prepared. So, on the Saturday evening following the Friday on which the argument had been heard, an upstairs room in the Rialto theatre was used for the purpose and a number of people were invited, including the two judges who remained in San Francisco and the counsel engaged in the case on both sides. The moving pictures included some of those used in the Miami trial, showing the action of individual bubbles on particles of mineral, oiled and unoiled. The making of froth by propeller-mixers, and enlarged views of the structure of froths, were likewise shown, but some of these must have been confusing—to the two learned judges, for example—because the froth pictures showed the effect of currents of air passing upward, although they followed immediately after the pictures of the propeller-mixing, to which they were in no way related. Indeed, to anyone that has seen, for instance, the moving picture of a man coming forward with his own head on a charger, it is not necessary to suggest that a cinematograph does not supply trustworthy evidence on a scientific subject. However, the show was interesting, and it was conducted in such a way as not to offend the opponents of Minerals Separation. The flickering was trying to the eyes and we were glad that the performance was short. On the Monday following, in the morning, a series of experiments was performed in the court-room before Judge Morrow and Judge Hunt. Preceding the demonstration the lawyers engaged in a dispute as to the amount of oral explanation that was to accompany the experiments. Mr. Garrison suggested that, in the absence of Judge Ross, there should be no description or explanation of a controversial kind. Mr. Bull suggested that there should be no repetition of experiments illustrating the prior art, such as had been threshed out and set aside by the Supreme Court. Judge Hunt suggested that as each experiment was made the respective counsel should indicate to what phase of the case it applied. Mr. Garrison contended that to do so would involve controversy. Judge Hunt demurred. Mr. Garrison insisted that it would reopen the argument, now closed. Mr. Sheridan explained what happened before the Supreme Court, which asked for an explanation of parts of the experiments in order to elucidate the issue. Judge Morrow said that, in the absence of Judge Ross, it would be improper to have any argument; counsel might agree to read the description of the experiments as it appeared in the record before the Supreme Court. He had asked about the machines, which he had seen in the room on the previous Friday, and when he had inquired why they were not used he had been told that there had been no time to do so. "We don't like the Supreme Court to get the best of us on information;" in patent cases, he said, the judges looked at the models left behind after a case had been heard and sometimes they attempted to work the models themselves —or tried to do it, unsuccessfully! Mr. Bull asked if his side might repeat one of the Minerals Separation experiments in a commercial machine, for comparison with the one that the other side made in a special bar-mixer. Messrs. Garrison and Williams protested that the proposed experiment was not in the record. Judge Morrow decided that the experiments must be performed under the limitations shown in the record. Counsel agreed. Appellant was allowed to say that a particular experiment was not made in a commercial machine. Here we may explain that the Butte & Superior people were anxious to show a froth-making experiment in a Janney machine using the coal-oil obtainable in the court-house, having made a test that proved that this mineral oil would make a good froth. The experiments were begun. First those for the Appellant were made by Messrs. Dosenbach and Engelmann, using Butte & Superior ore. They appeared to prove that a mineral-froth could be made first with 0.2% of pine-tar oil, and then with 1.62% of the same oil. Next a mixture containing 18% pine-oil, 12% kerosene, and 70% fuel-oil was used in the proportion of 1½% on the ore, in a Janney machine. This oil-mixture is the one used in the Butte & Superior mill. The recovery, according to the record, was 98.09% in a concentrate containing 44.3% zinc. Only three experiments were made by the Appellant, and they seemed to afford the desired demonstration. Then came eight experiments by the Appellees. These were in charge of Messrs. Higgins and Chapman. First they made a vanning test on a batea, to show the principle of concentration by water. Next Carrie Everson's second method was illustrated by vanning a mixture of acidulated water, ore-pulp, and oil (17%). The oil-buoyed pulp overflowed from the batea, leaving a sandy tailing. The third experiment was made in a Kirby machine, to show what an abortive method he described and patented. The fourth showed the agitation-froth process of patent 835,120. It was performed with 0.1% oleic acid on ore from the Black Rock mine of the Butte & Superior company. A slide-Gabbett machine was used. After a good froth had been produced, an addition of oil, to 3.7%, was made in order to produce the Cattermole effect, namely, granulation. The fifth experiment showed the froth-making quality of phenol (carbolic acid) and illustrated patent 962,678, the one for a soluble frothing-agent. The sixth, seventh, and eighth experiments were watched with the keenest interest by all those present because by these experiments the Appellees undertook to prove that kerosene and fuel-oil do not produce a mineral-bearing froth. Several little bar-mixers, such as are used in preparing frothy drinks, were employed. These mixers are operated by a miniature electric motor and provide an in-

tensive stirring. Experiment No. 6 was made with Butte & Superior ore to which sulphuric acid and copper sulphate had been added in the proportions employed in the mill. The mixture was agitated for half a minute; then kerosene, in the proportion of two pounds per ton of ore, was added, and agitation for two minutes followed. The record, which was read by Mr. Williams, stated that no froth, only "three or four bubbles," appeared, but as a matter of fact the experiment, when made on this particular occasion, did show a considerable froth, whereat Judge Morrow cast a quizzical glance at Mr. Williams. Then the experiment was repeated with the addition of a little pine-oil, an increased froth resulting. Experiment No. 7 was of the same kind; a mixture of kerosene and fuel-oil in the proportion of 18 pounds per ton of ore was added to the acidulated ore-pulp and again a distinct black (mineralized) froth was apparent, although the record of the same experiment as made before the Supreme Court stated that only "a few bubbles" were to be seen. The addition of pine-oil, in the proportion of four pounds per ton of ore, was supposed greatly to increase the froth, but as performed on this occasion the increase was not as great as the record suggested. The experiments were too numerous and they must have confused the judges, neither of whom were versed in the technique. The unexpected production of considerable froth when experimenting with mineral oils must have been a disagreeable surprise to the Minerals Separation people. As a matter of fact some varieties of kerosene froth nicely, others do not. It is doubtful whether the failure to demonstrate the non-frothing character of mineral oils will be accepted as evidence by the judges, because they are supposed to decide the appeal on the evidence in the record, and the record says that the experiments yielded no froth. However, the judges will be led to question the value of the experiments as evidence on contentious points. The proceedings of that and the previous day suggested the advisability of having a special judiciary or commission to try patent cases. The controversy over the froth-making qualities of the different oils reminds us that Minerals Separation stumbled upon the fact that a vegetal oil was effective even in minute quantity as against the large quantities of heavy mineral oils used in the prior art, so that, in applying for their patent, they disguised the essential fact by a wide claim covering all oils. They used oleic acid, whereas their predecessors had used heavy petroleum. The factors that make one oil effective and another ineffective for frothing are not yet understood by the experts on either side. We suggested to Mr. Williams that a moving picture of the mineral-bearing froth made by plain seawater would be interesting, to which he replied that the litigation had not yet caught up with that. Of course not; the litigation has always been a whole lap behind, and that is why so much of it has had an air of unreality. The technology of flotation has progressed so rapidly that the records of the various suits have been more curious than informing. The patentees of 835,120 knew precious little about the underlying principles of the process when they prepared their claims, and that is why they have had so much difficulty in applying them to current practice. We repeat what we have said before, that the opponents of Minerals Separation made a basic blunder in not demonstrating the practicability of the prior art, more particularly the Elmore vacuum method, instead of merely quoting it in rebuttal. The success of flotation in the mill is due largely to manipulative skill such as is covered by no patent and described in no book.

Metal Quotations

On our metal page each week we give quotations for ores and metals. For the former we give nominal prices, but for the latter the exact price. Occasionally we receive complaints—by letter and in person—saying that our quotations for ores are too low, or, for example, manganese, too high. It is most difficult to obtain current prices. Save in a few instances, ore-dealers or brokers hedge around in answering queries concerning prices; some refuse to divulge them. The West is not an extensive market for chrome, magnesite, manganese, molybdenum, tungsten, and other secondary ores, although they are mostly produced here. The markets are in the East, where these minerals are consumed. At the same time, Eastern manufacturers have agents or buyers in the West; but they are unwilling to give prices for publication, fearing perhaps that they might be bound by such, although names are not often published. We are independent of any influence in quoting prices, and will accept any schedule, provided it is from responsible firms. Something in the line of an ore clearing-house is needed in San Francisco, where buyers and producers can meet, also where sellers may ascertain the state of the market. The California Metal Producers' Association might be induced to help in this direction, as the business is important. In any case, it is impossible to give exact prices for ore, this being a matter of negotiation between dealer and producer, depending on analysis, situation of mine, and so forth. While on this subject it is apropos to mention that in the West are many deposits of low-grade chrome and manganese. The dressing of such ores to marketable commodity must be done some day, and it is pleasing to note that a start has been made. At several places in California and Oregon, chrome occurs disseminated as fine or large particles in serpentine. No amount of sorting would make such ore fit for sale, so concentration has been tried. In Canada and New Caledonia this has been done for several years. The same is true of manganese. We have personal knowledge of many Californian deposits high in silica that require dressing. At Crimora, in West Virginia, a large plant is extracting manganese from clay. At Butte, Montana, the Ophir mill of the Butte Copper & Zinc Co is dressing an ore carrying 23% manganese and 40% silica to 36% manganese and 10% silica, at a cost of $1 per ton of ore treated.



Smelters' Charges

The Editor:

Sir—Your paper has always been progressive in its attitude toward the producer of raw materials and ready to help mend such matters where justice is withheld. We all have noticed that the mining situation, as regards the production of ores, is growing worse rather than better. It was thought the high prices would stimulate production both from the large producers as well as from the larger majority, that is, the small producers, and many are the reasons advanced for these difficulties that have ensued. I wish to bring forward one more, not that it is a new one, but I have not as yet seen it mentioned.

In 1916, the Mineral Farm property which is close to Ouray, Colorado, leased by myself and managed by C. R. Wilfly, a progressive mining engineer of this city, mined and milled 1209 tons of ore having an average assay of gold 0.028 oz., silver 6.31 oz., and lead 6.48%. The concentrate averaged gold 0.068 oz., silver 27.70 oz., lead 30.6% dry, iron 8.2, zinc 3.7, silica 27.8, sulphur 16.5%. The average prices and quotations for the metals were as follows:

Average quotation for silver per ounce, New York, in crude ore, 66⅜c., and of concentrate 70.406c.; lead per pound in crude ore 6.789c., and in concentrate 7.0206c. The average price paid per ounce for the silver was 95% of the quotation, and for the lead in crude ore 2.982c., and in concentrate 3.135c. These prices for 1916 represent 95% of the silver and 43% of the lead that the consumer paid, out of which we paid all mining charges, freight, and treatment. What becomes of the other 57%? Is it possible for any small producer to be successful on the above percentage of what he produces? I claim it is only possible should he be lucky enough to strike a body of high-grade ore that can be mined as cheaply as the low-grade, and that this percentage will not allow any one sufficient money to continue in the business.

Large mining companies, having extremely favorable contracts with the smelters, or those that are equipped with their own smelting and refining plants, can continue operating.

The prices in 1917 on lead, silver, and zinc ores, as long as the metal content is practically the same as that above given, and the zinc average is at least 40%, are now getting practically 50% of the price the consumer pays. Our Government desires that the mining of metalliferous ores be increased, because of the War, but, since mining expenses as a whole have increased approximately 67%, how can one do this if there is not something done with the only buyers of the ores to make them give the miner a larger proportion of what the consumer pays for the refined product?

I have taken this matter up with a senator from this State and he has turned over our correspondence to the Mining Bureau and the Attorney General, but there is not much hope that anything will be done unless the mining papers and the mining interests join to compel the authorities at Washington to secure better terms in the only market the producers have, the custom smelters.

H. C. Branch.

Ouray, Colorado, March 1.

Flotation Physics

The Editor:

Sir—In his recently published letter, your unknown correspondent, Mr. X, displays a familiarity with physics and electro-statics which is refreshing after reading Mr. Norris's dissertation on Greek history and nominalism. I am reminded by the latter of a conversation I had in Bisbee last summer with one of our American Bolsheviki (an I. W. W.). He summed up the creed of his organization concisely when he said, "If we can't all ride in autos, nobody'll ride in 'em."

To return to Mr. X, he suggests that our inability to float native metals may be due to the ease with which a film of oxide is formed on them. When ores containing sulphide minerals are ground dry, a film of this sort often forms, necessitating the use of more acid than usual. This acid, however, removes the film and allows the mineral to float. I can see no reason why acid should not also remove any such film from native metals. Further, many metals in an extremely fine state of subdivision will float; but to me this means that while the metal displays some adhesion to a bubble, this adhesion it not nearly so great as that of a sulphide mineral, of which much larger particles can be picked up.

I cannot quite agree with Mr. X that the combined charges in a particle of a conductor and in the electrolyte immediately surrounding it will sum up to zero. The phenomenon of electro-phoresis makes it appear that they would add up to a finite quantity in most cases. If the charges in a particle summed up to zero before it entered the electrolyte, the most probable alteration of its condition would be that some of its latent surface-charge would be conducted away to the exterior surface of the liquid, the electric condition of the particle be-

coming similar to that of other portions of the interior of the electrolyte, especially if the conductivity of the particle and the electrolyte were in any way equal. Such an hypothesis might explain the differences in electrophoric polarity I have observed and discussed several times.

I had no intention in my previous letter of implying that these latent surface-charges or other electric properties did not play an important part in flotation; I wished, principally, to draw attention to such portions of Mr. Stevens's argument as I thought were not entirely clear. I am still of the opinion, nevertheless, that until we can explain the failure of Coulomb's law at molecular distances, it is not safe to depend on it in explaining flotation, as the distance between a solid surface and the adjacent molecules in an adhering film is not large as compared with a molecule. There is evidence that there may be an electro-magnetic field associated with even a stationary electric charge, and it is by no means impossible that at close range these magnetic forces entirely supersede electro-static forces. I still intend to discuss at more length the bearings of our knowledge of chemistry on the affinities and adhesions observed in flotation, but have been so far prevented by ill health. Meanwhile I shall take the liberty of asking Mr. X, if he has not already done so, to read Dr. Langmuir's articles, which appeared in the Journal of the American Chemical Society for November 1916 and September 1917.

JAMES A. BLOCK.

Phoenix, Arizona, February 26.

Nickel-Copper Steel

The Editor:

Sir—I was much interested in James W. Neill's article on the magnetic separation of Sudbury copper-nickel ores published in your issue of the 23rd instant. It is a puzzle to me where H. P. McIntosh, secretary-treasurer of the Canadian Copper Co., could have got the sample of ore sent to Mr. Neill. At this time, 1891, the C. C. Co. was working three mines, Evans, Stobie, and Copper Cliff, and the ore from these mines, like that from nearly all the others except one, will not act in the way specified by Mr. Neill.

A fairly clean or self-fluxing ore such as is regularly mined in the district consists of pyrrhotite, pentlandite, and chalcopyrite, with 10 to 50% gangue, mostly norite. Such ore when picked fairly free from rock, crushed and separated with a hand magnet, will give a heading carrying the greater part of the iron and sulphur, that is, the pyrrhotite portion, but it will run lower in nickel than the ore before separation. If the ore before separation carries 3 to 4% nickel the magnetic heading will run about 2%, while the non-magnetic tailing will run higher, owing to the fact that the pentlandite is not lifted by a permanent magnet and pentlandite carries over 30% nickel.

For years I was in the Sudbury district and made magnetic-separation tests on nearly every nickel ore in the district and some from outside, all of which, with one or two exceptions, acted as I state. The exception was ore from a small pocket, long since worked out, which was located between No. 2 mine and the McConnell of the C. C. Co. This ore acted as described by Mr. Neill and I took the mineral to be hazelwoodite. This ore was not touched till several years later than 1891 and it is not likely that Mr. McIntosh ever had a sample of it earlier than 1898. What is more interesting is the statement of Mr. Neill that he made these magnetic tests in 1890 or '91 and applied at that time for a nickel-steel patent based on magnetic separation of the copper-nickel ore. I struck the same idea about 1898 or '99 and was granted Canadian and U. S. patents on the process about 1900.

Edison was the first, to my knowledge, who ever attempted a magnetic separation of the Surbury ores, but he was working on a separation of copper from nickel, and as he and the aforesaid Mr. McIntosh could not agree on terms, the matter was dropped. Sjöstedt of the Clergue interests was the first to attempt the actual manufacture of nickel-steel from Sudbury ore, but, as he depended on hand-picking to free the nickel ore from copper and gangue, the method failed. Enough ore to keep even a small blast-furnace running that could be successfully handled by this sorting method has not been found in the district. His tests were started about 1899.

In 1907 I suggested my method to Le Grand Smith, then of the Ventura Corporation, and about a year later, in connection with J. D. Hubbard, of the Chicago Exploration Co., they obtained picked ore from the Whistle and Mt. Nickel mines. This ore was mixed, roasted at the Sault plant of the Lake Superior Corporation, smelted into pig-iron in the electric ferro-silicon furnaces of the Electro Metals Co., at Welland, Ontario, then shipped to Syracuse, New York, and made into open-hearth steel by the Halcomb Steel Co. Several tons of this steel was made, and upon actual test it proved better steel than nickel-steel made in the regular way; in fact, it was a great success. But, unfortunately, like many other attempts to get capital interested in such a new and novel enterprise, this one was unfortunate. The method not only saves most of the iron and puts the sulphur in better shape to extract, but it also enables most of the cobalt to be saved—nearly all of which now goes to waste—and also saves the trifling amount of silver and platinum metals contained in the ore, besides saving more nickel and copper, especially on the low-grade ores, than is now recovered.

There are no metallurgical obstacles to the process, every step has been carried out successfully on a working scale, and no royalties stand in the way, for the patents have about expired. Yet more than a thousand tons of the very best iron—carrying no phosphorus—and about the same amount of sulphur, practically free from arsenic, goes to waste every day in the Sudbury district, squandering the resources of the province to no purpose

except to destroy vegetation, irritate the inhabitants, and breed lawsuits.

If there is any business in North America that needs hooverizing, it is the Sudbury nickel industry.

D. P. Shuler.

San Francisco, February 27.

Instruction for Prospectors

The Editor:

Sir—In your issue of the 16th ult., I note you favorably mention the short courses of instruction to prospectors given in the Mackay School of Mines at Reno, Nevada. Also, your comment that "this departure in the teaching of the art of mining is well worthy of commendation."

This well deserved credit to the enterprise of that school is not criticized, but I wonder why you note it as a "departure," for such courses of instruction have been given at the College of Mines in the University of Washington here in Seattle for many years. And by the way, with splendid success. The course has attracted a large number of the more enterprising mine-workmen from Alaska and north-western States who have embraced this opportunity to improve themselves. One of these men is now superintendent of one of the largest mines in Butte. He was a common mine-laborer, who had but limited educational advantages, but with sufficient enterprize to take advantage of this opportunity. The 'short-horns', as they have been affectionately termed at the school, have numbered as many as 100, but I understand the attendance is not more than half that this winter, because of conditions which you will readily understand.

Maurice D. Leehey.

Seattle, March 5.

U. V. X. Bonanza

The Editor:

Sir—I have read with interest your article, 'The Story of the U. V. X. Bonanza,' in your issue of January 12. While, however, having no first-hand knowledge of the Jerome district, and approaching the subject simply from the standpoint of the student, I was struck by an apparent discrepancy between the geology as illustrated in the cross-section and in the accompanying text on page 47. In the cross-section there is certainly a suggestion that the older rocks, including the schist complex and intrusive quartz-porphyry and andesite, had been eroded by weathering before the deposition of the sandstone; whereas, in the text, one infers that the quartz-porphyry and andesite had been intruded after the deposition of the sandstone and limestone of Paleozoic age. The following quotation is from the article: "On the basement complex, after it had been deposited by weathering, there was deposited in late Cambrian times the sediment that now appears as beds of sandstone. . . . This series of rocks underwent the movements incidental to the adjustment of the earth's crust. . . . Breaks were followed by intrusions of magma from underneath, forming more dikes and tongues of igneous rock. The substance of these was the felsite and quartz-porphyry now exposed at the surface and underground."

I would desire to know which of these interpretations is correct.

A. G. Burrows.

Toronto, February 26.

[The "more dikes and tongues of igneous rock" that penetrated the sedimentary rocks were later than those that intruded into the basement complex, but the section is wrong because it fails to show the later intrusives that cut through the sandstone and the limestone. We thank Mr. Burrows for drawing attention to the error.—Editor.]

Patents

The Editor:

Sir—In your editorials, on various occasions, you have at least implied that valid patents could or should not be obtainable for certain inventions, and I can only conclude that you or I must be laboring under some misapprehension.

The particular inventions referred to are those in which a minute quantity of oil is claimed in flotation, another in which, in the manufacture of electrolytic zinc, the use of manganese is claimed, and in a third case you doubt whether the use of sea-water in flotation is patentable. I do not profess to know the details of any of these processes and I can only deal with principles, but in my opinion, the validity of patents in each of these cases is unquestionable.

If it is the case that a minute quantity of oil gives a better result than a larger quantity, there certainly is discovery, and if a minute quantity had not previously been used by others, it would seem to me to be illogical to consider a patent for this discovery to be invalid. Any one who objects is quite at liberty to use the larger quantity of oil to which he had before been accustomed.

The second case is that in which you question the validity of a patent for the use of manganese in the electrolytic production of zinc, because some ores have already some manganese in their composition. I have not read the patent specification of this invention, but I have at times read various accounts of this process, which I hear is likely to revolutionize the zinc industry. My recollection is that the presence of manganese has certain peculiar and valuable effects, without which the electrolytic process for zinc had previously not been commercially feasible. If the patentee of this process has drawn his patent specification wisely, he will have claimed the use of manganese in the solution which he electrolyses, and then it will not matter to him from whence it is derived, whether it be from the ore or not. Quite apart from this, provided it can be proved that previous inventions were failures commercially, through

want of the knowledge of the functions of this manganese, the inventor is entitled to a valid patent.

Many efforts had previously been made, I understand, to electrolyze zinc, and it is rather unfair to the patentee that others should make use of his discovery and defraud him of his just rights, with the excuse that they cannot help this ingredient being present in their ores. It is common knowledge in this district that the company with the large mine to which you referred knew that they had manganese in their ores before they made their contract with the patentee, and after they thought they had learned from him all the details, they coolly threw him over. Conduct of this nature cannot be too strongly animadverted and I hope the offenders may be brought to book.

In the case of your doubt as to whether the use of sea-water in flotation can form the subject of a valid patent, again I should say, certainly, if it can be proved that no one was in the habit of previously using sea-water for that purpose. It is certain that had it been known that sea-water is efficacious, as you anticipate it may be, in flotation, some one or other would be using it to escape the rigid and onerous terms of the Minerals Separation Co. If it was not known previously, then the only recourse open to those who wish to make use of the discovery is to recognize the patentee and pay up.

I would like it to be distinctly understood that I have no practical acquaintance with any of the processes I have dealt with, and that I have only looked at the matter from what I consider to be a fair and commonsense viewpoint.

R. J. MUNDELL.

Vancouver, March 4.

Gold and Silver Standards

The Editor:

Sir—I have read with interest your editorial on 'Gold, Silver, and Credits' and your correspondents' letters in this connection. The subject of credit is at all times an obscure one and especially so now. Any bank-note makes inflation, and even the ordinary bank deposit and the individual check, which has a restricted circulation, is a species of inflated currency. For some reason or other, gold has been the standard of value for centuries. Now, the exchange-value of gold has been decreasing for some twenty years and there are minor fluctuations that do our nation harm. Quite likely the scientific unit is an honest day's labor of the unskilled laborer and the effort exerted in a given period by a given number of laborers and their equivalent in skilled laborers in the finding of gold mines and the winning of gold can be translated into gold. Thus it may be said that in this manner society gets its standard of value—gold—in an equivalent of men-days. Now here steps in applied science. Improvements in mining, in metallurgy, in geology have all tremendously cheapened gold production and measured in man-days gold is now far cheaper than in 1890. Moreover, banking facilities have been greatly improved and the flow of money is so much faster that we have secondary inflation and expansion as a result.

Practically, a man wants money for its purchasing power. Therefore, if the dollar varies continually in purchasing power, it is like a yard-stick with a tremendous coefficient of expansion. Imagine the confusion resulting if women had to buy a yard of cloth for 75 cents on a warm day while on a cold day they would get only 30 inches. Yet just the same thing may occur with the monetary standard in a year's time. And much of the financial and industrial confusion can be laid to the varying intrinsic value of gold and the varying volume of credit based thereon, which causes the extrinsic value to vary.

Economists have long advocated a 'multiple' standard. Recently Professor Irving Fisher has been advocating as a standard of value a "full market-basket", which contains the average expenditure in goods of the average family, and that wages be paid, not in terms of dollars but in so many dollars as corrected by the price of commodities in the "full market-basket." Now, if it be true that we are drifting into a period of paternalism, and as paternalism reduces to a minimum unhealthy fluctuations in price, caused by sharp operations of the law of supply and demand by sharp people, some such scheme as Professor Fisher's might be made practical as a remedy for an unscientific and fluctuating standard of value.

Certain changes in society are sure to come. The evidence for this is the surprising number of conservative men who are discussing economic changes of a most astonishing character. When such men talk about things that a few years ago would have appalled them, it is certain that some of the schemes of the theoretical man and the visionary will be reduced to a working basis. Personally, I feel that we shall stop long before we reach a state of socialism or collective ownership and that we shall make popular certain old-fashioned virtues that were existent before the great influx of riches and ease, perfectly naturally, engendered in even the better class of men craft, cunning, and greed. Applied science has changed our life; science our ways of thinking. But human traits change very little in five hundred years. So, social changes may basically be not so radical as many people believe.

WOOLSEY MCA. JOHNSON.

New York, March 4.

PRIMARY aluminum made in the United States in 1917 was valued at $45,882,000, an increase of $11,982,000 over the value of that made in 1916. This increase appears to be due chiefly to an increase in the quantity of metal produced, but in part to an increase in the price of the metal.

ADVICES from official sources in Washington raise a doubt as to the availability of sufficient ammonia for refrigeration and ice-manufacture next summer. Consumers of ammonia will do well to give early consideration to the problem of obtaining the needed supply.

An American Policy Regarding Silver

By EMMET D. BOYLE and WHITMAN SYMMES

The situation of silver is paradoxical. The principal financial interests of the world contend that it is merely a commodity, and should be treated as such. When, however, China wanted to adopt a gold standard of coinage, pressure was brought to bear to compel her to retain silver as her money-metal. While vigorously advancing the doctrine that it is a mere commodity, these same financial interests deny to silver the right of free flowage in the markets of the world and they regulate it with monopolies, embargoes, and banking restrictions for the very reason that it *is* a money-metal.

In order to understand the silver situation it is necessary to appreciate how the interests involved are lined up. Silver production is an American industry. The principal Canadian and Mexican mines are owned in the United States. The British empire, except the Cobalt district, is not an important producer of silver. From the commodity standpoint, therefore, it is to the interest of the British to supply their requirements at as low a price as possible, and it is to the interest of the American producers to sell it for as high a price as possible.

Furthermore, in regard to its use as a money-metal, the British ideas are directly opposed to the American interests. Our economists have generally held that we are best off when the people with whom we deal are prosperous and have a large purchasing power. Great Britain, on the other hand, still clings to her old notion that it is better to keep the standard of silver as low as possible, in order that the British pound may buy goods in silver countries at comparatively low prices. The British think only of their own purchases, whereas it is American policy to consider the purchasing power of China and other nations with whom we desire to work up reciprocal trade.

Great Britain is the principal purchaser of silver, which she ships to India, 'the sink of the precious metals,' where it is used for coinage, for personal and other ornaments, and for hoarding; and she ships it also for distribution in the Orient through her marvelous system of exchange-banks. By maintaining a low price of silver Britain is able to purchase her Oriental goods at a more favorable rate of exchange.

The price of silver for the entire world is fixed in London by a group of four brokers known as the 'fixing board'. They operate under ancient Crown patents, a relic of medieval institutions, and all other people are prohibited from dealing in silver. There are no opening or closing bids, or high, low, or closing sales. One price is agreed upon for that particular day, and all silver changes hands at the price fixed.

Having fixed the price that their clients in London are willing to pay, the brokers who compose the 'fixing board' monopoly generally telegraph to New York and make their purchases. The New York price follows the London price, less the cost of transportation, insurance, assay, and abrasion. Transportation is 2%, insurance has recently been 4%, assay is one shilling per bar, and abrasion is figured at one-fifth of 1%. The London price is in pence per troy ounce 925 fine, whereas the New York price is in cents per troy ounce 999 fine. The purchaser pays the London brokers' commission, which is one-eighth of 1%.

The only real rival to London as a silver-trading centre is San Francisco. In spite of the manifold controls that London exercises on the silver market through the fixing board, the Indian government, and the British-Oriental exchange-banks, silver continually finds its way from San Francisco to the Chinese market through non-British institutions. Moderate amounts of silver can always be sold in San Francisco for more than the London-made New York price, and occasionally, as has happened recently, San Francisco becomes a silver market all by itself.

To show how London is able to control the price of silver, a single instance will suffice. Last September the New York quotation was \$1.09½ and silver was being sold in large quantities at \$1.15⅝. Great Britain then placed an embargo upon shipments of silver into and out of India, and allowed it to be handled only by the Indian mint. At that time there were orders on the New York market for ten million dollars worth of silver for shipment to the Orient. About two million dollars worth had been purchased when the British Oriental banks suddenly withdrew all exchange on New York. The purchasers were thus left with no way to pay for the silver already bought, so that they were forced to throw it back upon the market. These sales, the cancellation of the Chinese demand, and the closing of the Indian market, united to force the price down to 84½ cents.

More recently the United States was considering the payment of \$40,000,000 in silver to Japan for ships, but in order to hold the price down, Great Britain devised a way to cut out this demand. The British government borrowed 80,000,000 yen from Japan, and then applied this Japanese credit in New York as payment on one of her American loans. The net result is that the United States pays forty millions of the British loan instead of paying that amount to Japan, and Britain owes Japan forty millions instead of the United States owing it.

Great Britain desires to continue in control of the silver market for the following reasons:

First, to get cheap silver for her coinage in India, and

for other uses there. She has fixed the gold-exchange value of the Indian rupee corresponding to a silver value of 94.37c. per troy ounce, and by getting silver for less than that price the Indian mint has made a seignorage profit of $51,000,000. If silver goes above that price, the Indian mint must lose, instead of profiting by its coinage, and if bullion were allowed to be shipped out of India a price above about $1 per ounce would cover the costs of transportation, insurance, refining, and exchange, and would cause the rupee to disappear from circulation. It may be remarked that the Indian silver rupee is now also circulated in Mesopotamia and Egypt.

Second, to maintain a low price and therefore a favorable rate of exchange for her purposes in China. The Chinese tael is not a Government coin, but merely a weight of silver, and is equivalent to 1.2 troy ounces 931.5 fine. Britain would rather buy eight taels worth of goods in China for a pound sterling than only three taels worth.

Third, to control the Oriental trade. By being on the inside of the silver market Britain has been able to operate to the advantage of her own interests, and to the disadvantage of her rivals. The fluctuations in the price of silver may more than offset a fair commercial profit. One who has not actually lived in the Orient has little conception of the vast amount of daily speculation in silver and exchange. It is not only a common form of gambling, but it is a necessary part of every commercial transaction with a gold-standard country. With the British in control of the silver market, American firms have about as much chance to compete with the British as a lamb has to survive on Wall Street. This means that American firms must confine themselves to American specialties. Otherwise, sooner or later, the insiders will win.

Prior to our Civil War, the American tonnage on the oceans was almost as great as the British, and the Americans were a considerable factor in the Chinese trade. The last of the great American firms in China was Russell & Company of Canton, and they had a large number of steamers in the Chinese coastwise trade. About twenty years ago they sold their fleet and retired from business. On being asked the reason for this their manager replied, "If I were to name *one* reason I would say that it was the difficulty of handling the silver exchange." We have seen the price of silver fluctuate by 24% in the last few months, and the effect on a company that, for example, is handling a million dollars worth of silk and guesses wrong on the silver market needs no comment.

Fourth, to make profits from the Oriental exchange. All of the British Oriental banks are known as exchange-banks, and expect to make their principal profit, not from deposits and loans, but from exchange transactions. In an uncertain market naturally the charges are all the higher. Not long ago the price asked for exchange from New York to India was so great that Williams, Wigmore & Co. refused to pay it. They found it profitable to charter a ship and transport their own silver to India.

We should have an American policy in regard to silver, for the following reasons: First, to obtain an adequate remuneration for American labor and American investment, and for the wasting of our natural resources. It can be pointed out here that, in spite of the increased price for silver during the past year, profits have not increased, and the production of the State of Nevada in 1917 was 2,443,000 oz. less than in 1916.

Second, for the development and continued existence of an Oriental trade. As matters now stand it would appear to be necessary to establish efficient American banking agencies throughout the Orient, but if the price of silver is stabilized Americans could then safely use the established British banks until such time as American trade was developed to larger proportions.

The effect of a good and stable price for silver acts both directly and indirectly to assist the government of a silver-standard country. Last September, when silver was $1.10 per ounce, the following letter was mailed to the London 'Times' from its special correspondent at Peking. "The advance in the price of silver, and the consequent rise in exchange have revolutionized the financial position of the government of China. The dollar today is practically worth double the average value before the War. Thus China, in meeting her heavy foreign obligations, has to provide only half the number of dollars that were previously needed. Meantime the salt revenue is greater than it has even been, while the maritime customs revenue, in spite of the restriction upon trade, maintains itself in a manner that is remarkable. The position is well illustrated by the circumstance that whereas the customs revenue used to be insufficient by some £1,000,000 annually to meet the Boxer indemnity and other payments secured on it, it is now carrying all these liabilities, together with the whole of the interest on the Reorganization Loan of £25,000,000, and up to the end of July there was, in addition, a surplus of about £2,000,000 available to the Government. There is, in fact, every reasonable chance that China, during the next two years, will have enough surplus funds to pay off outstanding debts, to redeem paper, and to standardize her silver coinage without borrowing a penny from abroad."

Last September Sir Rufus Isaacs, now Lord Reading, headed a mysterious mission to Washington. Thereupon the silver market became paralyzed. It was announced in Parliament that the British government was negotiating with the United States government for our entire output of silver. A little later it was rumored in London that the deal had been consummated, and that Lord Reading, who upon his return was rewarded with an earldom (the only Hebrew except Benjamin Disraeli ever to attain that dignity) had been thus honored because of his successful deal at Washington. Such, however, does not appear to be the fact, and it is much to be hoped that nothing of that sort will ever happen. We should maintain a distinctive American policy in regard

to silver, one that is in accord with our democratic principles. We should help Great Britain in every possible way in this war, but it is not necessary for us to assist her in maintaining a monopolistic relic of the special privileges of the Middle Ages such as the London 'fixing board.' Neither is it necessary for us to discriminate against our own silver producers and to subscribe to the doctrine of cheap silver which she so stubbornly adheres to.

We should fix a fair price for silver and we should stabilize that price. The natural demand for it is admittedly far in excess of any possible production, now or in the immediate future. There is at present no natural difficulty in evidence. India is prosperous and will absorb all the silver that is allowed to go thither. A fair price for silver will make China more prosperous, and the more prosperous it becomes the more silver it will want. The Chinese government voted to coin 150,000,000 oz. of silver, but has never been able to make the purchase. Of the entire world's production of 150,000,000 or more, only 110,000,000 oz. ever gets into the markets of the world. In the United States alone we use for the arts about 22,000,000 oz. of new silver per year. The amount of money involved in stabilizing the price, even under adverse conditions in the distant future, would never be great as compared with the results achieved. At present no money is required for that purpose, but the price of silver is 'stabilized' downward by various restrictions on its use. A fair price will do justice to our silver miners, encourage the development of business, and increase the purchasing power of the foreign nations with whom we desire in the future to deal. A stable price will decrease wasteful speculation and lay a safe foundation for our merchants during that critical time in the future when they are getting established in business with the silver-standard countries.

Our present one thought is the Great War. It may be said that the future for silver should wait. But war conditions and the consequent tremendous demand for silver have made the question a very present and a very live issue. The decision as to our policy should be made now.

THE EUREKA LILY MINE, in the Tintic district, Utah, a neighbor of the Tintic Standard on its western side, is getting ready for development immediately. A drift is being driven from the 1400-ft. level of the present shaft. The Eureka Bullion Mining Co. has a shaft already completed to the 600-ft. level. A hoist sufficient for work to a depth of 1000 ft. has been installed. The Iron King Mining Co. has resumed development, after having been idle for several years. Machinery is being placed for sinking a shaft to connect with the long tunnel that was completed some years ago. When this is finished the shaft will be below the tunnel-level and in the underlying limestone. At the Zuma property a winze started from the 500-ft. level has been sunk to a depth of 80 ft. It is proposed to continue driving on the 600-ft. level. New equipment has been ordered for the property.

Coal in Alaska

Acting under the Alaskan Coal Leasing law, the Interior Department is endeavoring as rapidly as possible to develop the coal resources of that country, with the idea that whatever production is obtained soon will not only be of valuable aid to Alaska but will also be a factor in winning the War. With a production of 50,000 tons in 1917 from the Matanuska field and the prospect that this output will be doubled this year, Secretary of the Interior Lane recently announced that 19,000 acres of coal land in the Nenana field are now ready for lease under the provisions of the leasing law. The coal land, which constitutes the most accessible part of the surveyed lands of the Nenana field, extend from the Nenana river up the valley of Lignite creek for 12 miles. The mouth of the creek is on the approved survey route of the Government railroad under construction between Fairbanks and Seward. The Alaskan Engineering Commission expects to complete the road from the Tanana river to these lands during the next summer and in this way furnish transportation for coal for barge-shipment to Fairbanks and other river towns. The Commission will also build a branch road up Lignite creek to bring the coal from the mines. The coal occurs in several thick beds, is easily mined, and is a lignite of fair grade. It is probable that it will be used chiefly for railroad, river-boat, and domestic fuel. This coal land is divided into 23 leasing blocks of 10 to 1664 acres. Applications to lease may be filed with the Commissioner of the General Land Office, Washington, up to March 1, 1918, or during the period of advertisement of the applications filed up to that date, which will be for a period of 30 days, beginning March 4, 1918. Applications may be filed for a single block, or for two or more contiguous blocks, the total area in a single lease not to be over 2560 acres.

OIL conservation has led to an investigation of water-power resources in the Pacific Coast States, and the following table shows present development of this source of power:

State	Minimum potential water-power	Practical development under present conditions	Installed capacity in operation
Arizona	893,000	280,000	33,700
California	3,424,000	1,100,000	731,000
Nevada	172,000	20,000	13,500
Oregon	3,148,000	950,000	176,800
Washington	4,928,000	1,200,000	333,600
Total	12,565,000	3,550,000	1,288,600

Steam-power installations in the Western States total 1,729,600 hp., of which nearly 50% is in California.

LATITUDE and longitude of nearly all important points in the United States can be ascertained with exactitude from Bulletins 216, 245, 310, 440, and 496 of the U. S. Geological Survey, to which the Director has again called particular attention.

Potash Prospects in Montana

By O. W. FREEMAN

It is believed that lakes have been located in central Montana which contain enough potash to make its extraction profitable at present prices. The gently rolling surface of the Great Plains east of the Rocky Mountains in Montana is broken by several small mountain uplifts. North of the Missouri river are the Bearpaw and Little Rocky mountains. South of the Missouri are the Highwood, Moccasin, Judith, Little Belt, Big Snowy, and other groups. The Bearpaw and Highwood mountains are mostly composed of lava flows. The others have been formed largely by folding, accompanied by laccolithic intrusions. A large number of dikes and several laccoliths are found in and near the Highwood mountains. These rocks have been studied in detail by L. V. Pirsson (U. S. G. S. Bulletin 237). He gives a considerable number of analyses of the igneous rocks, which he classifies as fergusite (leucite), shonkinite, missourite, highwoodite, and others. Most of the analyses show that a high percentage of potash is present in these rocks; many average over 8% potash, while some contain as much as 11%. Pirsson estimates that the original intrusive magma contained 6.1% K_2O, which was increased in certain rocks by differentiation. Should methods be perfected to extract potash from complex silicates these rocks would prove a valuable resource. High-potash rocks also occur in the Judith, Bearpaw, and Little Rocky mountains.

The slow disintegration and decomposition of the high-potash rocks would liberate large amounts of it in soluble potash. It is believed that flood-waters would dissolve much of this potash, along with other alkaline salts, and carry them to undrained lakes and waterholes where they would be concentrated. Several lakes occur north of the Highwood mountains and close to the small towns of Geraldine, Montague, and Square Butte. These towns are stations on the Chicago, Milwaukee & St. Paul railroad, between Great Falls and Lewistown. The lakes cover a total area of many square miles, and are nearly all close to the railroad. The bedrock in this part of Montana is the Colorado shale, of Cretaceous age, which is impervious to water, and as the lakes have no outlet they disappear only by evaporation. Hence there has been a considerable concentration of alkaline salts. Some of the salts have been deposited as white incrustations around the lakes and in low areas that are covered temporarily by flood-water, but it is questionable if such deposits are of commercial importance. The water of several of the lakes has been analyzed. Some of the analyses are said to show over 7% potash in the alkaline salts of the lakes. Sodium chloride and sulphates are the most common salts present. It is doubtful if the salts that impregnate the soil about the lakes contain as much potash as the lakes themselves. Insufficient data have been secured to show whether the extraction of the potash will be commercially profitable, but it is believed, by those who have investigated the matter, that there is enough potash in several of the lakes to permit its recovery at a profit, at least while the present high prices continue. Leases have been applied for that cover many thousand acres of Government land, including both the lakes and the soil impregnated with alkaline salts. Great Falls and Lewistown men are chiefly interested. Several sections of State land have also been leased. Development work will be continued, and if the results are favorable it is hoped to erect a plant near Geraldine for the extraction of potash next summer.

It is probable that a thorough testing of lakes elsewhere in Montana, especially in the northern part of the State, between the Milk and Missouri rivers, would show the presence of potash. It is doubtful if the potash content in any of the lakes of central Montana is high enough to make its extraction profitable at the low prices existing before the War, but it is thought that the industry offers a good chance for profits at the present time.

Handling Gasoline for a Mine Engine

Special care must be taken in handling gasoline. Most engines as purchased have fixed tanks into which the gasoline must be poured from the container in which it is brought into the mine. This arrangement is bad. More accidents with gasoline engines have resulted from a man carrying a naked light or smoking while filling such fixed tanks than from any other cause. In drawing gasoline, or in pouring it from one container into another, static electricity may be generated. It has been shown by experiments that unless the containers are grounded and are in electrical connection with each other, the accumulated electricity may discharge by a spark sufficiently strong to ignite the gasoline vapors. The use of portable tanks will entirely eliminate this danger. At the filling station the tanks should be connected electrically in order to prevent such accumulations. Cans with handles of wood or any other insulating material should never be used for handling gasoline. If a hose with a metal nozzle is used, a bare copper wire inside the hose and soldered to the nozzle and to the tank-connection will complete the circuit. If a can and a funnel are used, they may be attached to the tank with light copper or brass chain. The safest method of handling the gasoline for an underground engine is in a portable fuel tank. After the tank is filled on the surface, and all openings are closed, it is carried into the mine and connected directly to the fuel-line of the engine to serve as the fuel-supply tank. With this system it is not necessary to pour the gasoline from one vessel into another in the mine.—U. S. Bureau of Mines, Tech. Paper 174.

GOLD holdings of the United States on February 1, 1918, amounted to $3,038,545,652, compared with $2,912,465,116 a year ago. On August 1, 1914, holdings were $1,887,270,664.

Drawing Pillars in Metal Mines

By W. R. CRANE

Constructive ingenuity coupled with experience has solved many of the difficult problems encountered in metal mining, and not the least important of such problems is that of pillar-drawing.

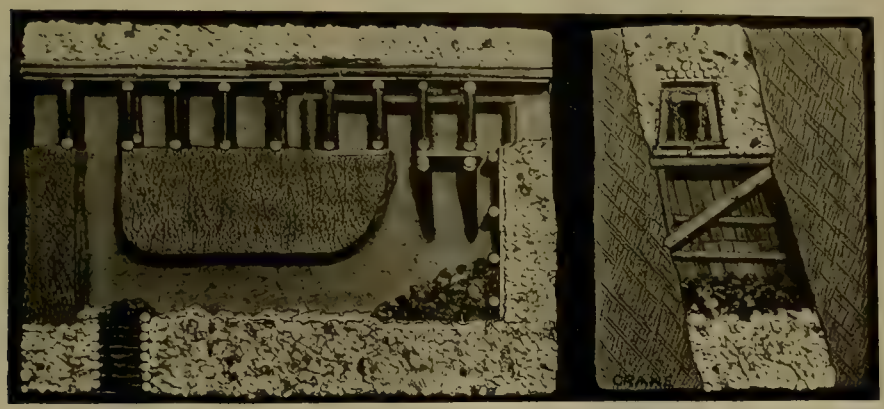


FIG. 1. REMOVING ARCH-PILLARS UNDER FILLED STOPES, AUSTRALIAN PRACTICE

The method of procedure adopted varies, of necessity, with the method of mining or stoping employed, as, for instance, where the ore is mined by ordinary overhand or underhand stoping methods and supports; or where caving is applied in the preliminary method of ore extraction. In order to provide against falls and therefore to make the workings as safe as possible during the mining of the pillars, it is desirable that the stopes should be filled with waste, which is added to as rapidly as space permits following the systematic removal of the pillars.

The essential considerations in the drawing of pillars regardless of how accomplished are: speed, continuous operation, systematic handling of ore and waste, and safety to men and mine.

Brief descriptions are given herewith of the drawings of the two principal forms of pillars, namely, the lateral pillars or the large unmined portions of ore temporarily left for protection between stopes and consequently running parallel with them and transversely across the lode or orebody, and top and bottom pillars or arch and floor pillars situated at the top and bottom of stopes.

While there has been a large number of methods devised to meet different conditions of occurrence of ore and methods of mining, yet in this connection only those methods are discussed that illustrate successful pillar-drawing under normal conditions and adapted to narrow and moderately wide veins and to filling and caving methods.

The usual operation of mining arch-pillars in narrow veins is commonly spoken of as 'lifting' or 'picking up bottoms,' and consists in cutting out the ore in small sections and the placing of stulls or square-sets as rapidly as possible. A filling of waste is not absolutely necessary provided the stopes above are not filled or are only partly filled. With filled stopes considerably more care is necessary and consequently more skill is required, although, as previously pointed out, the prime requisite is rapid and continuous work, when pillar-drawing is once under way.

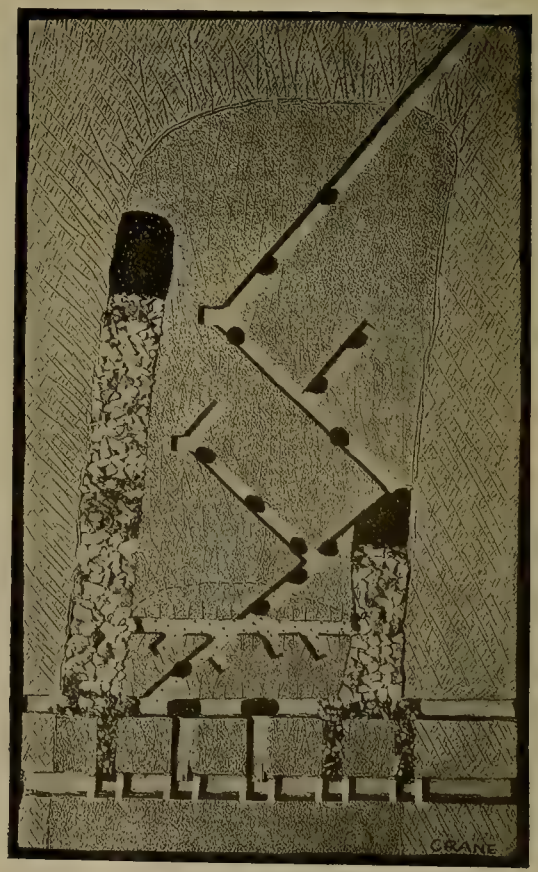


FIG. 2. PILLAR-DRAWING BY CAVING, BRADEN COPPER MINE

A method of removing arch-pillars that has been employed with considerable success in the Australian mines may be used to illustrate such work as applied to moderately narrow veins. A stope having been worked out and filled with waste to within 10 or 15 ft. of the level above, the work of removing the remaining ore or the arch-pillar is begun. Winzes are sunk through the pillar from the level and a drift is run on top of the waste uncovering the waste-chutes previously used in drawing off ore from the stope. The drift is next enlarged laterally until the walls of the vein are reached and such supports as are needed are placed. Sections of the pillars ranging in length from 25 to 50 ft. and extending from hanging to foot-wall are thus blocked out. Beginning at one end of a section or block of ore, it is removed by retreating, but care must be taken not to undermine the sets in the level above. This is accomplished by placing two large timbers or draw-bars under the caps of the sets and supporting them with posts that stand on unmined ore at either end, or after the work has got well under way, one post will be placed on ore, the other on the waste-filling. See Fig. 1.

The sills of the undermined sets are held in place by chains until supplementary sills and braces in the nature of stulls can be placed. Filling is then stowed in the excavated space and held in place by stulls and lagging giving final and complete support to the sets. Successive sections are thus mined, the supporting drawbars advanced and sills caught-up, and filling introduced; the advance being rapid, sure, and safe. Failure to properly catch-up the sills may result in a collapse of the sets and a consequent run of waste-filling from the stope above. The level would then be permanently closed and considerable ore lost by crushing of the arch-pillar; there would also be danger of a cave starting, which might seriously disturb the workings.

The problem of pillar-drawing in the Braden copper mine, in Chile, has been successfully solved by the adoption of a novel method, which is, however, little more than the caving system adapted to the mining of pillars.[1] The stopes in the Fortuna orebody of the Braden mines have lengths of 131 to 361 ft. and widths of 20 to 33 ft., while the intermediate pillars are 26 to 40 ft. wide. The vertical height of stopes is about 300 ft. The stopes stand full of broken ore until such time as the 'reserve' can be safely drawn upon. See Fig. 2. It has been calculated that two-thirds of the output of the mine must ultimately come from the drawing of pillars, and consequently the method adopted must meet the requirements of regular production and low cost, and at the same time not endanger the mine through collapse of the workings either in pillars or stopes.

Experience seemed to indicate the desirability of depending upon hanging-wall pressure to break up the ore and cause it to move to its point of delivery after the preparatory work has been done by means of large blasts or a series of blasts. Dilution of pillar-ore through mixing with broken cap-rock, were the pillars to be left standing until the ore in the stopes is first drawn, was the deciding factor in the choice of method of drawing pillars finally adopted.

The stopes are extended to the desired height and left full of broken ore; the intermediate pillars are then attacked. The first operation is the opening of stopes on both hanging and foot-wall sides of the pillars, which are carried to the top of the finished stopes or at least one-half their height. The stopes are worked from the upper of two drifts run through the centre of the base of a pillar, connection between the drifts being made by vertical chutes, which are made funnel-shaped at the top. Space is provided in the pillar-stopes for the miners by drawing off the surplus ore through the chutes. On the completion of the pillar-stopes the pillar is almost entirely surrounded laterally by broken ore, and the unmined block of ore stands upon a base of limited extent, which is also perforated by drifts and chutes.

Beginning at the top of each chute, wide cross-cuts are driven across the pillar, the object being to determine the width of the pillar. The pillar is then honeycombed by broken-sloped chutes, which zigzag back and forth across the pillar from hanging to foot-wall. Further, small cross-cuts are driven across the pillar from stope to stope, thus giving access to a large part of the block of ore. The ore from the preliminary work of raising and cross-cutting is handled through the same passages that serve as manways. Sub-levels are also driven at more or less regular intervals throughout the height of the pillar, the first being spaced at a distance of about 16 ft. above the second of the two bottom drifts, and serves as a basis for the work of caving the pillar.

The preliminary work of driving, raising, and cross-cutting having been completed, the bottom of the first sub-level is attacked at regular spaced intervals and shallow pits are sunk. In the walls of the pits, as well as the sides and tops of the first sub-level and the lower raises and cross-cuts, numerous holes are drilled and charged with dynamite, which when fired shatters the base of the pillar causing it to settle and thus start the caving of the whole block of ore. The pressure of the hanging wall and the broken ore in the stopes acting together cause the pillar to disintegrate, and when the ore is drawn off through the chutes below, that in the pillar and the stopes mingle and move downward together and comparatively free of waste. Care must be taken in driving the cross-cuts and other passages that might come in contact with the broken ore in the stopes, otherwise danger to the miners is almost sure to result from running ground. Further, in order to ensure against mixing of ore, it has been found necessary to draw off the ore regularly and uniformly, and by so doing the subsidence of the cap and the holding back of the waste is handled to the best advantage.

An interesting method of drawing pillars is now in common use in the iron mines of our northern States

[1]'Pillar Caving at the Braden Mines,' by J. D. Tallant. 'Teniente Topics,' June 1916, No. 6.

and in Canada. This is a combination of sub-level mining, pillar-drawing, and caving.

The lode at the Magpie mine, Michipicotan, Canada,[2] varies from 25 to 62 ft. in width, which variation is shown in Fig. 3. The method of development and working is given in both section and plan, Fig. 3 and 4. In the lower left-hand part of the plan the general method of procedure in opening up the block of ore to be stoped is shown; in the lower right-hand portion of the plan, the development work has been completed and stoping begun; while in the upper portions of the plan the stores are in various stages of exhaustion.

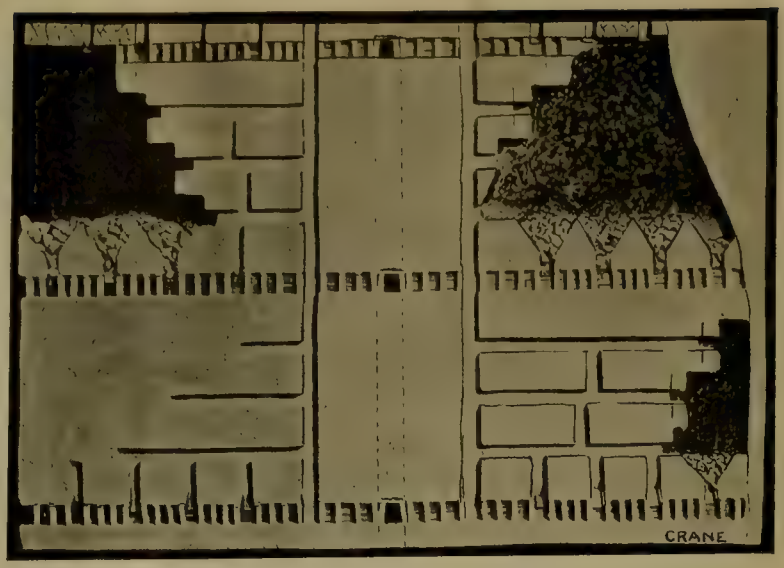


FIG. 4. PLAN OF STOPES IN MAGPIE MINE

In the working-stopes the blocks of ore are subdivided into horizontal layers by sub-levels, which presents, points of attack in the breaking of ore; the working face of each sub-level is carried in advance of the one directly above, thus giving a bracketed effect to the stope-faces. The blocks of ore are then mined first by advancing with the sub-levels, following which the pillars are mined by retreating, but each working-face is protected by the projecting back of ore above. The ends of the pillars are drilled and blasted by holes placed vertically in both the roofs and floors of the sub-levels, the broken ore falling freely to the floor-pillars below, in which block-holes and funnel-shaped chutes are provided for the prompt and efficient handling of the ore. The miners are also able to retreat into the sub-levels should there be indications of serious falls.

As the work of mining the pillars proceeds, it is obvious that in the course of time the floor-pillars of the upper levels will lose their support through the removal of the arch-pillars and consequent abandonment of the levels below, and furthermore they become weakened by the constant fall of ore from the elevated stope-faces, which with the weight of broken ore will cause them to crush and collapse, ultimately falling to the bottom of the next lower stope-floor.

[2] 'Block-Caving and Substoping,' by F. C. Roberts, 'Mines & Minerals,' June 1912, p. 674. 'Mining Methods at the Magpie Iron Mine, Canada,' by A. Hasselbring, Canadian Mining Institute, Bulletin, March 1917, p. 261.

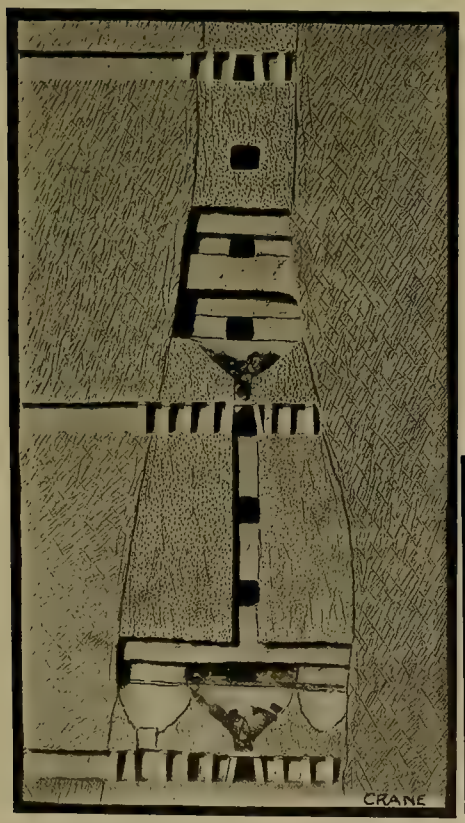


FIG. 3. PILLAR-DRAWING AT MAGPIE MINE



FIG. 5. DRAWING PILLARS UNDER FILLED STOPES

The first operation in pillar-drawing in this method is accomplished by overhand and underhand stoping, gravity giving assistance in breaking down the ore. The second operation consists in mining the floor-pillar by caving. Both are done at slight expense and with a high degree of safety and efficiency.

The drawing of pillars in massive deposits, particularly where the conditions of the ore and wall-rock are poor and bad, presents difficulties not ordinarily encountered, yet even under the most adverse conditions a a large proportion of extraction from the pillars is possible. A good illustration of such work is to be found in the iron mines of the North as in Michigan and Minnesota.[3] The work of mining is accomplished by overhand stoping and filling with waste commonly known as back-filling.' See Fig. 5. On carrying a stope to a height that has been found by experience to be safe, the unmined portion of ore left standing or the arch-pillar is attacked next to one wall, preferably the foot-wall, and a break-through formed, whereupon the waste in the stope above runs into the lower stope until checked by filling the available space. By proper care in placing the breaking-down shots the back of ore is caused to cave and fall, being pushed forward along the stope by the downward movement of the incoming waste. Ordinarily the arch-pillar may be reduced to a thickness of 10 to 12 ft. or less by the usual work of overhand stoping, so that the work of breaking down the pillar is comparatively easy and when once begun may continue with little or no further effort except the removal of the broken ore, which gives room for the introduction of more waste from above. While there are possibilities of danger from the extensive crushing of the pillars and the loss of ore, yet with the exercise of proper care a large part of the ore can be removed with comparative safety to the miners and mine.

Necessity for the conservation of the ore supply even in the low-grade deposits has been responsible for the careful consideration of means to that end and the methods cited are typical of the work that is being done to bring about such results.

Quicksilver in 1917

The domestic output of quicksilver in 1917, according to statistics compiled by H. D. McCaskey, of the U. S. Geological Survey, was 36,351 flasks of 75 lb. each, valued at the average quoted market price at San Francisco ($106.12 per flask) at about $3,857,000. The output was the greatest since 1883. The production in 1916 was 29,932 flasks. The productive States were California, Texas, Nevada, Oregon, and Arizona. The output of California in 1917 was 24,251 flasks, against 21,045 flasks in 1916. Quicksilver prospecting and mining, stimulated by war-demands, have been active. In 1917 the Abbott mine became a producer, with prospects of a considerable increase in 1918. The Helen mine continued production, and the Sulphur Bank made gains that are likely to be continued in 1918. The Big Injun was a new producer. The Patriquin continued production, and the output of the Bella Union and La Joya showed considerable gain. The New Idria yielded slightly more than in 1916 and remained the largest producer in America. The Cambria was idle but the Oceanic increased its output. The New Almaden and New Guadalupe both showed material gains. The St. Johns again made a large output. The Culver Baer, Great Eastern, Cloverdale, and Socrates all made gains, those of the first three being notably large.

The output of Texas was 10,759 flasks against 6306 flasks in 1916, and the increased production is credited to the Chisos, Big Bend, Mariposa, and Chisohm, in the order named. Further increase may be expected from the Terlingua district, which was long ago put on the map by these mines.

The production of Nevada decreased from 2198 flasks in 1916 to 916 flasks in 1917, the decrease having been due in part to loss of the Goldbanks plant by fire and in part to decreased production from the Ione district. Properties near Mina made notable increases, especially the Red Devils or Farnham and Drew properties. In Arizona and Oregon combined the production was 422 flasks in 1917 against 383 flasks from these States and Washington combined in 1916.

The market prices of quicksilver quoted in San Francisco increased from an average of $81 per flask in January to $126.25 in February, but declined to $113.75 in March, $114.50 in April, $104 in May, and $85 in June. In July the average rose to $102 and in August to $115, falling in September to $112 and in October to $102, rising again in November to $102.50 and in December to $115. The average for the year was $106.12, but producers received, as usual, considerably less for metal sold at the mines. The high prices were due to greatly increased war-demands, principally for making fulminate for explosives, antifouling paint for ship bottoms, drugs, and storage batteries, and for amalgamating gold and silver ores, but were due also to the large increase of exports over imports. The exports of quicksilver for the first ten months of 1917 were 10,222 flasks, against 8880 flasks for the entire year 1916, and the imports were 4491 flasks for the first 9 months of 1917, against 5659 flasks for all of 1916.

Most of the output continues to come from properties that were producing before the War, but part of it comes from old surface material, for new development work and furnace construction require time and money, and quicksilver deposits, unlike the larger deposits of the more common metals, are not readily measurable in a quantitative way. Uncertainty as to war-demands and post-war markets and prices have prevented extensive financing of an industry in which there had been little profit for decades before the War. Some improvement in the treatment of low-grade ores is indicated.

[3] 'Iron Mining in Minnesota,' by C. E. van Barneveld, Fig. 126.

Minerals Separation v. Butte & Superior

PART OF BRIEF FOR PLAINTIFF-APPELLEE

Appellant's contention of non-infringement includes (and stands or falls with) the proposition of law that the patent in suit, as interpreted by the Supreme Court decision, covers and includes *every oil or oily liquid that has a preferential affinity for metalliferous matter over gangue.*

That this *must be* Appellant's contention is evident from the fact that Appellant's procedure since January 7, 1917, involves every ingredient, step, operation and result, that its earlier (and admittedly infringing) procedure involved (including the use of a small fraction of 1% of an oily liquid—pine oil—that does the work of the process), and in addition it involves the use of a large fraction of 1% of an oily liquid—petroleum—that does not, and cannot, do the work of the process, the two fractions when added together equalling 1% on the ore or more.

That this *is* Appellant's contention appears on page 44 of its brief:

"Hence we see that any oily liquid having a *preferential affinity for metalliferous matter over gangue* is included within the term 'oily liquid' in the claim. Since there is no question but that petroleums have such *preferential affinity,* and the court below has in terms so found, there can be no question but that they are included within the term 'oily liquid' contained in the claims." (Italics theirs.)

This construction of the patent is arrived at by mistaken emphasis upon an incidental thing and an entire failure to recognize the essential thing.

It is conceded by both parties and found by the court below that all oils possess the characteristic of preferential affinity for metalliferous matter over gangue. Comparatively few oils, however, possess the characteristic of producing a mineral-carrying froth. The soul of the invention of the process in suit resides in using an oil having the characteristic of producing a mineral-carrying froth; incidentally such oil will exhibit the characteristic, common to all oils, of preferential affinity for metalliferous matter over gangue.

To construe the patent as if the only thing sought for in the oil is its preferential affinity for metalliferous matter over gangue is to specify a characteristic which is common to all oils and therefore does not serve to distinguish the oil required; and it overlooks that which does distinguish the oil required and specifies its essential characteristic, namely, its capacity to produce a mineral-carrying froth.

One has but to read the claims and the specification to demonstrate this, viz.

(Claims 1, 2, and 3):

"agitating the mixture *until the oil-coated mineral matter forms into a froth,*"

(Claims 5, 6, and 7):

"agitating the mixture *until the oleic acid has been brought into efficient contact with the mineral AND has formed a froth therewith.*"

(Claim 12):

"*agitating the mixture to cause the oil-coated mineral to form a froth,*"

(Claims 9, 10, and 11):

"*agitating the mixture to form a froth*" [limited by disclaimer to the same mineral-carrying froth as the other claims].

It will thus be seen that the explicit requirement of every claim is that the oil or oily liquid in addition to coating the mineral particles must do the fundamentally essential thing, i. e., it must cause the oil-coated mineral particles to form into a froth.

This it does by reason of its mineral-froth-forming capacity or characteristic.

If the oil fails in this respect the process does not proceed.

If it is incapable of fulfilling this office—if it is lacking in this characteristic or power—it is not the oil or oily liquid of the claims.

The specification is equally explicit.

It sets out the discovery, the mode of operation, and the result, all as centring in the froth or scum thus constituted by the air-bubbles and their adhering oil-coated mineral particles.

And the Supreme Court decision, in upholding the patent as valid and to that end defining the process and pointing out its novelty over the prior art, specifies even more emphatically the operation of mineral-froth-formation, including the formation of a multitude of air cells, the adherence of the oil-coated mineral particles to them, the lifting of the latter by the former, and their accumulation as a floating froth, and specifies this froth as the result obtained by the process and describes it as consisting of air-bubbles modified by only a trace of oil in their films and carrying in mechanical suspension in their films a very high percentage of the mineral content of the ore.

Oils may have different characteristics. For example, preferential affinity for metalliferous matter over gangue, lifting force in water, stickiness, and, in the case of the process in suit, the modifying action which results in persistent mineral-holding-froth formation. One characteristic may be utilized in one process and another in another process.

The characteristic or power of oil to form a persistent

mineral-carrying air-bubble froth was first disclosed by the patentees here, and is the distinctive feature of Appellees' process, and is the only explanation that has been made by anyone of the process as used by Appellant.

By the very necessity of the case the patent is limited to such an oil or oily liquid as will do that thing and excludes every oil and oily liquid that will not do that thing.

And the Supreme Court so confines the patent by explicit and authoritative interpretation.

This is in epitome the prescription of the patent:

Given ore, water, acid, heat, and agitation nothing results.

Given ore, water, acid, heat, oil, and agitation nothing may result or something may result. If the oil is an oil that, like kerosene or fuel-oil, does not have the characteristic that produces mineral-carrying froth, nothing will result. It it is an oil that, like oleic acid or pine-oil, does have that characteristic. an air-bubble froth will result in which the bubble-films are modified by the minute amount of oil in them and hold or carry a very high percentage of the metalliferous matter of the ore. If the ore or the oil are new and untried a simple preliminary test, says the patent, must be made to determine whether the oily substance is suitable under those conditions in the respect of yielding the proportion of froth or scum desired, namely: a froth or scum carrying a large proportion of the mineral present.

That this description and prescription are sufficient the Supreme Court has already held.

And this inclusion of every oil or oily liquid that will do this work and exclusion of every oil or oily liquid that will not do this work, is imported into all of the claims, as is manifest on the face of those claims as pointed out above and on the face of the disclaimer with respect to claims 9, 10, and 11.

Appellant's brief seeks to escape the fatal force of this situation by misrepresenting Appellees' position.

It asserts by assumption that Appellees' position is that this fuel-oil and kerosene in Appellant's process is wholly inactive, wholly inert, for any purpose, does not take "any active part in the process," is used "only as a diluent to increase the bulk of oil."

This misrepresents Appellees' position. Appellees' position is this: These oils do not possess the capacity to produce mineral-bearing froth and it is immaterial therefore on a question of infringement whether they are inactive or active, beneficial or detrimental, in other regards. Whatever action ensues from their use is incidental merely, and is negligible and immaterial on the question of infringement.

They may stabilize the froth, they may tend to prevent metal dropping out of the froth or perform some other incidental thing; but it is purely incidental. They do not cause the process to work, and therefore they are not the "oily liquid" of the patent.

If the terms of the claims are to be construed by the real substance of the invention—if a given ingredient is to be tested by the real work that it does in the process, or by its capacity to do, or not to do, that work—if the claims in their use of the terms of the art are to be intelligently understood and applied from the standpoint of the end and purpose in view, the function and operation to be performed, the results to be obtained—then the oil or oily liquid of the claims is to be interpreted and construed as such an oil or oily liquid as will do the essential work of the process, as will function and operate in the way specified in the patent, and in the claims themselves, and as will obtain the results defined in the Supreme Court decision, and to which, as that decision holds, the patent must be confined.

When you have once so construed the claims, when you have once so determined, as you must, that no oil or oily liquid is the oil or oily liquid of the claims that does not, and cannot, function and operate, and produce the result, there set out, it only remains in any particular case to determine whether the oil or oily liquid in question does in fact so function or operate and bring about the result. On this question of fact in the case of the fuel-oil and kerosene used as Appellant uses them the findings of the court below are clear and specific and certain, and they were based upon what was practically the concurring testimony of both sides.

And when Appellant contends that an oil or an oily liquid that will not produce the results obtained by the process is nevertheless the oil or oily liquid of the claims because it has a preferential affinity for metalliferous matter, it flies in the face of the Supreme Court decision which holds that the patent "MUST BE CONFINED" to the obtaining of those results.

* * * * * * *

The claims of the patent in suit, so far as the use of oil or oily liquid is concerned, define clearly, distinctly, and imperatively what must be used, i. e., an oil that is capable of producing a mineral-froth under the conditions of its use—and for the purposes of the only question of infringement presented in this suit, we may deal with the patent just as if it were restricted in terms to a fraction of 1% of such an oil upon the ore.

To determine infringement, therefore, is a perfectly simple matter and requires only the consideration of a fact. The only fact (if the procedure of the patent is otherwise used) that needs to be considered is, how much mineral-froth-forming oil is being used to form the froth. When the investigation discloses that the quantity of mineral-froth-forming oil is a fraction of 1% on the ore and that the results specified by the patent and the decision are obtained, infringement exists even on the strictest and narrowest construction of the claims. The infringer, upon this state of facts, can no more successfully resist the charge of infringement by saying, "But I also used other oils making in the aggregate of all kinds of oil more than a fraction of 1% on the ore," than if he should say, "In addition to the fraction of 1% of mineral-froth-forming oil which I used, I also used some

acids or some solids or liquids of various kinds and with various names and functions."

It is impossible to add apples and pears and get an aggregate of apples.

It is utterly immaterial upon the issue of infringement in this case (even assuming the narrowest construction of the claims) what non-frothing oils or what other things are used, if the user employs the procedure of the patent in suit and in that procedure uses a fraction of 1% of mineral-froth-forming oil, and obtains the results specified in the decision.

The Appellant is in just this position, and the whole situation on the issue of infringement is luminously clear.

The Findings of Fact Made by the Court Below on the Issue of Infringement

The Court below, facing all the witnesses who testified on the facts, and personally viewing the many experiments and tests that were made in court during the progress of the trial, and viewing the two processes in the mill (Appellant's and Appellees') on the last day of the trial, the one at the Appellant's mill and the other at the Timber Butte mill (one of Appellees' licensees) found the following facts:

that

"The larger part of the oil used by the defendant and all in excess of a fraction of one per cent on the ore, if not inert is ineffective, wasted, and injurious to the process and results";

that the petroleum-oils which constituted a large part of the oils

"seemed generally ineffective by the evidence of both parties";

that these petroleum-oils

"are ineffective to operate the process and that is because they have not the quality that contributes to bubble-making. * * * With these ineffective oils agitation will not produce froth and so there is no flotation of the metallic particles"; that

"Defendant uses the patent process, uses plaintiffs' invention of ore concentration by air-bubble flotation, uses the same elements in the same combination in the same way with the same function to the same, but poorer results"; that

"The addition of the excess oil no more adds to or changes the process, no more avoids infringement than would the addition of milk or other useless substance not a part of the process";

and that the excess oil was added

"merely to avoid the patent."

The Evidence

These findings of fact by the court below were based upon credible testimony of reputable witnesses produced by both parties—practical experts in this art such as Mr. Greninger, Mr. Chapman, Mr. Higgins, and Mr. Wiggin for Appellees, who not only testified to their observations and opinions, but some of them made practical demonstrations of the facts in court; also Mr. Engelmann of the Ray Consolidated Company, a practical expert in this art produced by Appellant, who testified to mill-tests,* and Professors Bancroft, Taggart, and Beach, scientists produced by Appellant, and Messrs. Wilding and Wilkinson, practical experts who interpreted for the Court Appellant's tabulated statement and monthly reports as to its procedures both before and after January 7, 1917.

Mr. Higgins for Appellees *demonstrated* by a test carried on in open court *that a mixture of fuel-oil and kerosene* (two of the three components of Appellant's mixture) in an amount *aggregating* 18 *lb.* to the ton (faily typical of Appellant's mixture), when added to a mixture of ore, water, and acid, *would not upon agitation produce a mineral-carrying froth or effectuate any ore concentration whatever,* but that when to that mixture of ore, water, acid, and 18 lb. of fuel-oil and kerosene, 4 lb. of pine-oil per ton of ore was added and the same identical agitation repeated, a copious mineral-carrying froth was produced, and ore concentration was effected. Mr. Higgins made a similar demonstration, trying first 2 lb. of kerosene with ore, water, and acid, which upon agitation gave nothing whatever in the way of a metal-carrying froth, and to which he then added 2 lb. of pine-oil per ton of ore and repeated agitation, whereupon a good mineral-carrying froth was produced.

Some of Appellant's witnesses testified to sporadic mill-operations said to be with petroleum alone, but they were discredited and the operations shown not to have been with petroleum alone. Janney admits knowing many oils that will not froth and another class that will froth and make the bubbles stable. Professor Bancroft, one of Appellant's scientific witnesses, repeatedly says that kerosene is not a frothing-oil and selects it as the typical non-frothing oil, and says of Appellant's mixture that it contains (1) the non-frothing viscous oil, fuel-oil (2) kerosene, which he had selected as the typical non-frothing oil, and (3) pine-oil which is a frothing-oil.

Appellant's brief apparently seeks to suggest, by italicizing the words 'kerosene' and 'alone' in the phrase "kerosene acid sludge alone" that the Anaconda company as Appellees' licensee sometimes uses kerosene alone in its great flotation operations. Kerosene acid sludge is not kerosene at all, but a by-product of the refining of kerosene, and it contains no kerosene. Mr. Wiggin says also (and this may help explain where some of the large amount of inert and useless petroleum-oil goes to in Appellant's process) that the Anaconda company has found that aluminous clay material in the copper slime probably absorbs some of the oil used, rendering that much of the oil useless for flotation, this explaining why it is found necessary to use more oil with the copper slime. Appellees' witnesses speak of the great excess of clay-

*"We tried at different times to run on straight fuel-oil, but we could never maintain metallurgical results."

gangue slime in Appellant's ore and of the probably large absorption of fuel-oil and kerosene thereby, and the reports of Appellant's mill superintendent show that of every 26.37 lb. of oil added in the demonstration mill run on April 29, 1917, more than 10 lb. were found running to waste in the tailing, where, of course, the proportion of gangue is large.

That the Appellant's procedure since January 7, 1917, is substantially the same process, proceeding by the same identical operation to the same identical result—the metal-carrying froth—is testified to positively by the practical experts Greninger, Chapman, and Higgins, produced by Appellees, and counsel for Defendant below stated that it had been satisfactorily proven by his witnesses that the same results are obtained with over 1% as with under 1% of oil and the operations of Defendant demonstrated this. He particularly referred to his witnesses, Professors Bancroft, Sadtler, Taggart, and Beach.

Appellant's brief cites no evidence or opinion to the contrary, and the Appellant in its brief here seeks the benefit of an argument to escape conviction of infringement by intimating or suggesting that it obtained by its operations a different result from that obtained by the process in suit. It cites no evidence to sustain this argument. It points out no difference whatever between the principle and mode of action and operation of the process as carried out after January 7, 1917, and as carried out for five years before that date, nor any difference whatever in the product of the process, the resulting froth-concentrate. The argument, therefore, not only lacks any basis in fact to support it but is in direct opposition to the testimony of the witnesses on both sides. The whole effort of the Defendant in the court below was directed at proving that the results obtained by large quantities of oil in the aggregate above 1% were identical with the results obtained by quantities below 1%, and its counsel urgently insisted there that the Defendant had established this fact.

However effective the argument now made might have been, if the facts of the case had supported it, it is utterly futile because the facts do not support it but on the contrary destroy it.

The case is well within the rule that was stated in the opinion in Butte & Superior Copper Co. against Clark-Montana Realty Co. and Elm Orlu Mining Co., filed at this term by this court.

"There are several assignments of error to the findings of fact, * * * The Appellant does not assert that the findings of fact are unsupported by competent evidence, he contends that they are contrary to the weight of the evidence. The trial court made its findings upon an evidently careful and painstaking investigation of the testimony and the exhibits, and after a personal inspection of the mining properties. We have examined the record sufficiently to see that the findings are all supported by the credible testimony of reputable witnesses. Upon settled principles which this court has always recognized, findings so made upon conflicting testimony are conclusive upon this appeal."

We have on the facts here a perfectly clear case of a user of the exact process of the patent in suit who seeks to escape the charge of infringement by adding thereto something other and different that does not go to the heart of the operation or change its substance or change the kind of product or result obtained. Under the law this does not relieve such user of the charge of infringement. There is no real dispute on the facts, and they are the sole determining test of infringement. The facts demonstrate infringement from January 7, 1917, to the time of trial.

The fuel-oil and the kerosene which, when employed in minute proportions in conjunction with minute proportions of a mineral-froth-forming oil and with a soluble frothing agent of the 1910 patent, sometimes benefit the result by preventing the dropping of some larger mineral particles out of the froth and by steadying and stabilizing the froth, may in the uselessly excessive quantities employed by Appellant effect that same benefit, or it may not. The weight of evidence is that it does not. But even if it does, that benefit does not change the process in its substance and does not change the results obtained in kind.

It is worse than foolish to say, as Appellant's brief says, that the result is different because the Appellant's profits are being reduced at the rate of $1,000,000 per year, with the intimation that that was the sort of result the Supreme Court referred to in its decision. This is foolish because there was no ore concentration process known to the prior art by which any profit at all could be made except water concentration (and that did not involve oil) and the Elmore bulk-oil process (which required ton for ton of oil and ore and which even Defendant's witnesses all differentiate), and perhaps Cattermole (which recovered the metal and could only recover the metal by sinking it). The Supreme Court could not by any possibility have had any increase of commercial profits in mind as the "results obtained" to which it says the patent must be confined. And the argument is worse than foolish in that it discloses the emptiness of Appellant's armory of argument to support its contention of non-infringement.

It is also a simple begging of the whole question to say that the Appellant's froth-concentrate has contained more oil since January 7, 1917, than it did before, because the very question is whether the presence of the alien oil in the froth-concentrate that gets there from the operation makes that froth-concentrate any different in kind, or the operation by which it was produced any different in kind, and the evidence on both sides is that it does not.

It is idle too to argue that Appellant's froth has more oil in it since January 7, 1917, than before, and that that was the distinction the Supreme Court made between Appellees' froth and the prior art; for that was not the distinction the Supreme Court made. The Supreme

Court did not find in the prior art a froth the air-bubbles of which carried a large proportion of the metalliferous content of the ore and in addition *a large quantity of oil* from which it differentiated Appellees' froth merely by the *lesser quantity of oil* in it. That was emphatically not the situation. The Supreme Court found a broad novelty in Appellees' froth which it defined, as we elsewhere point out, and Appellant's froth since January 7, 1917, is as much that novel froth in kind as was Appellant's froth prior to that date.

* * * * * * *

Validity

The second question to be decided is:

"Has the Appellant proved the existence of any state of the prior art substantially different from that which was passed upon by the Supreme Court in the Hyde case?"

The answer is that it has not. The contrary answer (if a contrary answer be intended) is not urged in Appellant's brief with insistence or any indication of conviction.

The California Journal of Technology is the only document of the prior art that was not before the Supreme Court, but Appellant's brief does not even mention it. It appeared for the first time in the Miami case and was dismissed by Judge Bradford as discussing laboratory tests that far from suggesting the possibility of the invention pointed to an opposite conclusion. It was dismissed by the Circuit Court of Appeals in that case with a mere mention, and was dismissed by the court below in this case as detailing a "suggestive but rather misleading and abandoned experiment."

The new evidence mentioned in Appellant's brief at pages 63 to 71 does not relate to the prior art. The mill-operations there referred to with quantities of oil above 1% did not any one of them separately or altogether reproduce any process of the prior art. Those procedures only employed what Appellant's brief repeatedly terms "prior-art quantities of oil" (an ingeniously misleading expression) in subsequent-art procedures. As matter of fact every such mill-operation without exception included a soluble frothing-agent in the mixture employed, thereby utilizing an invention that was not made until 1909 or thereabouts, and every such operation employed a fierceness and violence of agitation that were undreamed of in the prior art, and every such operation employed a Janney machine, which gives a peculiar kind, as well as an extreme degree, of agitation, and which was not devised until 1913 or thereabouts. Similarly all of those operations employed as the main ingredient of the oil-mixture certain petroleum products that Dosenbach and Janney after two or three years of investigation (beginning in 1913 or 1914), during which thousands of oils and oil mixtures were tested, had discovered to be inactive in this process and yet not destructive of it. Such operations cannot possibly cast any light on the prior art.

The new evidence as to the enormously extending use and utility of the process since the testimony in the Hyde case was taken, the new evidence as to the subsequent surprising discovery that a material which went completely into solution in the water and remained there and could not and did not coat the mineral particles yet caused a similar air selection and separation and lift and produced a similar mineral-carrying air-froth, and the new evidence of scientific men as to the philosophy of the proces, all tend most strongly to confirm and emphasize the Supreme Court's conclusion of fact that a new operation and result was in fact obtained, and to confirm and emphasize the Supreme Court's discriminating definition of that operation and result as an air separation and lift and a modified air-bubble holding or carrying of the mineral matter in a froth that persisted long enough for convenient separation.

The argument made before the Supreme Court by counsel for Appellees here, and which is quoted on pages 64 to 68 of Appellant's brief, was an argument addressed in part to the use of a mineral-froth-forming oil of the patent in suit in proportions greater than 1% on the ore (in procedures which Appellees' counsel contended and their witnesses testified *did not represent the prior art*) and that argument is just as sound on the record in the case at bar as it was on the record in the Hyde case, for in this respect there is no testimony in the case at bar additional to that in the Hyde case. That testimony shows the failure that ensued when Mr. Higgins attempted to employ cotton-seed oil (a mineral-froth-forming oil of the patent) in an amount equal to 3.6% on the ore in a miniature plant, and the failure that ensued when Mr. Chapman put through the same operation in a full-sized plant with 1.8% of oleic acid. Appellant in its brief asserts that these operations were successful metallurgically and bases his whole argument upon that assertion. As the assertion is absolutely unjustified by the evidence, the argument based upon it utterly falls. Both operations were abject failures and entirely justified what was said of them in argument by counsel for plaintiffs in the Hyde case. The proper deduction from the results of these operations establishes the soundness of Appellees' position that, so far as the evidence showed in the Hyde case and shows here, the use of more than a fraction of 1% of an "oil of the patent" has not succeeded in the mill.

The evidence in the case at bar does not in the slightest degree disprove what these experiments established, for not a single one of the mill-operations testified to or proved in the case at bar with quantities of total oil at or above 1% on the ore, as we have already said, employed more than a fraction of 1% of mineral-froth-forming oil. The oils that were in fact employed in quantities greater than a fraction of 1% on the ore were alien oils that would not alone and of themselves and without the presence of a frothing-oil of the patent in suit or a soluble frothing-agent of the 1910 patent, in any proportion or quantity, large or small, effectuate the operation or bring about the result of the patent in suit. This new evidence therefore confirms the evidence on which the Supreme Court decision was based.

Placer Platinum

Platinum, osmium, iridium, palladium, ruthenium, and rhodium form a group of closely related metals, which are generally found as native metals more or less alloyed with each other. They are rarer than gold, and some of them, especially platinum, iridium, and palladium, are now more valuable and in greater demand than gold. Because of their difficult solubility, their fusibility only at very high temperatures, and their extreme hardness, they are especially suitable for use in the chemical and electrical industries. One of its most important present uses is in making sulphuric acid, for through catalytic action it brings about the combination of materials required to form that acid, which is needed for making fertilizers and explosives and is thus essential to sustain the feeding and fighting powers of our Nation.

Under normal conditions the United States requires about 165,000 oz. of the platinum metals per year. It produces only a few thousand ounces and is meeting increasing difficulties in importing sufficient quantities. In this emergency we find that we have not utilized all our natural resources and that we have lacked the imagination to foresee the value of some of these resources. Henry G. Hanks, a former State mineralogist of California, as far back as 1884 made the following statement: "If the miners could be persuaded to collect the platinum minerals an industry might be established of considerable importance. There is no reason why platinum should not be manufactured in San Francisco and the American demand in part or wholly supplied by this State."

A comprehensive survey of our platinum resources was begun by the U. S. Geological Survey during the field season of 1917, the work in California being done in co-operation with the California State Mining Bureau.

The problem of increasing the production of the platinum metals is closely involved in the production of placer gold. The modern dredge, which is capable of handling as much as 200,000 cu. yd. of gravel per month, has become a highly efficient tool, but it is capable of still further improvement. If the gravel is clean and comparatively free from sediment, the dredge recovers most of the gold and platinum from the gravel that is handled, but if a large amount of fine mud or sediment is mixed with the gravel, it is not so effective. Over 30 dredges were at work in 1916, in California and Oregon, and during that year 710 oz. of crude platinum was produced. By careful experiment one dredge operator estimated that his dredge has been losing 4¾ oz. of platinum per month. More efficient methods may yield some increase in the quantity of platinum recovered.

Old stream channels buried beneath the lava on the western slopes of the Sierra Nevada formed the feeders of the gravels in the areas along the foothills that are now being dredged. These buried channels are mined by driving or tunneling under the lavas, bringing the gravels to the surface, and recovering the placer gold. Some of these old channels carry considerable platinum aside from the gold, and at a few places attempts are being made to mine them more extensively.

The hydraulic mines in northern California and southern Oregon are producing some platinum along with the gold. The proportion of the value of the platinum to that of the gold produced at some of these mines is about 1 to 20. Unmined gravel deposits along streams in this area contain platinum and should yield a considerable quantity of the platinum metals. The main problem at most of these deposits is to get sufficient water for mining. Large reserves of the platinum metals are probably locked up in these gravels, to be recovered when the cost of mining is reduced by more favorable conditions.

The beach sands along the coast of Oregon and California have long yielded gold and platinum. The sands mined include not only those of the present beaches, but of old beaches that now stand about 200 ft. higher. The sands of the present beaches were in places so rich that in the early days they caused one of the great stampedes recorded in the history of California. The problem of mining the black sands of the beaches has been an alluring one, and many attempts have been made to mine on a large scale. A successful method must be based on a thorough prospecting of the material, which varies in richness not only vertically, but horizontally.

No reliable method has yet been found to handle these beach sands, though during the season of 1917 preparations were being made at several places for working them on a large scale.

Some platinum is recovered by small sluicing operations that are in progress near the headwaters of many streams, where the gravels are shallow and where the gold and platinum are close to their source in the bedrock. The platinum metals are generally supposed to be derived from the serpentine that occurs in many areas in northern California and southern Oregon. Wherever platinum seems to have been traced nearly to its source this rock is found. A roughness of the platinum and in some specimens a black or brownish coating, which is apparently iron oxide, indicates proximity to its source, but it has not yet been traced directly to the serpentine, although it is probably derived from this rock. Streams that drain areas of serpentine would seem to be particularly favorable for prospecting. At no place are the platinum metals concentrated in large quantities. Being rarer than gold, they are harder to find than gold. Iridium is in great demand, and the fact that it forms 10 to 40% of the platinum metals in nearly all the placer deposits in the United States is a special incentive to the search for more. The elimination of litigation and the equitable settlement of questions regarding surface rights and underground rights in drift mining and regarding the distribution of water for irrigation, power plants, and mining might also increase the output.

Potosi Mines, Santa Eulalia

*The mines of the Chihuahua Mining Co., and of its predecessor, the Potosi Mining Co., constitute part of the central group of the Santa Eulalia district, Chihuahua, Mexico. The important mines belonging to this company are the Santo Domingo, Potosi, Santa Rita, Fortuna, Coronel, Zubiate, and Leonidas. As their ores, the same as those of the great majority of this district, are present in the form of mantos and in caves, the latter being locally called *abras*, and as the mineralization frequently extends to the surface, it is logical that the early miners should have explored these deposits from adits, but even in times past, they were beginning to search for the deeper-seated orebodies. In 1888 development was undertaken by means of a central shaft, which penetrated to a depth of 150 metres, and which in that period was considered a notable work for Mexico. Another was sunk on the Santa Rita 370 metres deep, and another on the Coronel, 240 metres deep. The Potosi Mining Co. has developed its property by means of two shafts, one 550 and the other 370 metres in depth. All of these shafts are well made and well timbered. The mechanical equipment is on the highest plane of modern progress, and is manned entirely by Mexican mechanics. It also has a pumping plant established near Tabaloapam, which takes water from a well on the banks of the river Chuviscar. The water is pumped through a pipe-line 19 km. long, and is used for steam generation at the plant of the company, and also constitutes the supply for the workmen and for the town of Santa Eulalia. They have constructed, and have succeeded in maintaining, even through the recent years of trouble, a narrow-gauge railroad, which gives them an independent outlet to the old Robinson plant, where connection is made with the Central Railroad. The sampling of the ore is done at this point, where the cargo is broken. The Chihuahua Mining Co. from 1894 to 1896 operated a smelter at the Robinson Hacienda, in which were smelted, during that period, 28,555 tons of lead ore, from which was recovered 3768 tons of pig-lead and 529,450 oz. silver. The mines of this concern have been exploited at all times in the most active manner, and although it has always been necessary to do a great deal of development work, they maintained a minimum production of 300 tons daily in the earlier years of the enterprise, which has risen during the years of bonanza, until today the output reaches 800 tons per diem. Such a production gives one an idea of the large reserves of ore available, and it is interesting to note that the deposits are of remarkable uniformity, both vertically and horizontally, the diamond-drill having shown an uninterrupted persistence of pay-ore to a vertical depth of more than 800 metres, and extending over an area more than 70 metres in diameter without finding the limits of the deposit. The metallic content of the ore in the upper zone has been greater than that on the lower levels although the diminution in value with depth has not been great. Neither has there been a complete change in character of the ore, the carbonate of lead predominating along with oxides of iron, although sulphides are becoming more abundant. As has been indicated, there exist, in all the levels of the mines, immense caverns, which possess irregular forms, and have at times surprising dimensions. For example, one cavern measured 200 metres long by 15 wide. In its upper part it was covered by a crust of carbonate of lead containing also nodules of galena. The iron was oxidized and the silver existed in the form of chlorides, bromides, and native metal. The floor of the majority of these caverns is formed of masses of ore fallen from the roof, although in some cases the floor is practically clean, while the walls are covered with crystals of calcite and gypsum. The ore in these caves is generally so soft that it is possible to bar it down, rarely requiring the use of dynamite. The cost of mining under these conditions falls below ₱2 per ton. Formerly it was the custom to begin the workings in the arch of the caverns, throwing down first the 'despegue,' that is, the crust of ore which covered it, by means of a system of scaffolding, but the cost of timber necessary for these structures was so great that they frequently omitted this precaution, trusting to the strength of the walls, with the result of detaching large slabs from the walls and precipitating the workmen to the bottom. It is said that thousands of men have lost their lives in this way.

In addition to the deposits in the form of mantos and in caverns, the mine of Santo Domingo also has a contact vein between the beds of limestone and a dacite dike, which traverses this property as well as the adjacent mines to the north and south. Also in the Potosi mine there exist deposits of zinc blende and calamine of such size that they have been able to mine 400 tons per diem of this kind of ore. These deposits are found in the upper levels chiefly, where they were first discovered, but they also extend to the lowest workings of the mine.

*Abstract: Boletin Minero, Oct. 1917.

THE IRON ORE mined in the United States in 1917 amounted to about 75,324,000 gross tons, compared with 75,167,672 tons in 1916, an increase of 0.2% only. The shipments from the mines in 1917 are estimated at 75,649,000 tons, valued at $236,178,000, compared with 77,870,553 tons, valued at $181,902,277 in 1916. The general average value of the ore per ton at the mines for the whole United States was therefore $3.12 in 1917, as compared with $2.34 in 1916. The stocks of iron ore at the mines apparently decreased from 10,876,352 gross tons in 1916 to 10,560,000 tons in 1917.

GOLD consumed in the industrial arts of the country during 1916 was valued at $51,061,187, according to the director of the U. S. Mint, of which $41,120,149 was new material. As the United States production of gold during that period was $92,590,300, the industrial consumption of fresh material amounted to 44% of the production.

Concentrates

TIMBER-MEN in mines, to be safe from falls of ground, should do their special framing under timbered ground, not ahead of it.

JEWELRY demand in India is such that since the War started 20,000,000 sovereigns ($4.80 each) have been melted to supply the gold needed in manufacture.

GOOD WIRE-ROPE LUBRICANT not only oils the wires, and thereby reduces the action of friction, but it also protects the rope from action of acids and other injurious elements.

WASTE ROCK, unless resting against strong barriers, is not an effective support for stopes dipping over 33 degrees; but below that it is quite effective. This is South African experience.

SILVER is mainly a by-product, and the greatest factor in its production is high prices for the base metals associated with it, rather than an increase in the price of the precious metal itself.

SILICA-GRAPHITE PAINT coated on the interior of steam-boiler drums prevents pitting and formation of scale. A little flake graphite added occasionally with the feed-water is also beneficial.

MIGRATORY NATURE of labor is illustrated by the fact that at the Hollinger gold mine, in 1917, there were taken on 2700 men and paid-off 2600 men. An average of 1045 were employed in all departments.

MANGANESE is a beneficial impurity in zinc ores treated by electrolytic methods. It oxidizes the iron, and is re-oxidized in the electrolytic cell. When re-oxidized it is again available to oxidize the iron, in fact, it acts as a catalytic agent.

HIGH COPPER CONTENT (0.86%) of medium-carbon (0.38%) steel renders the metal superior in strength, hardness, and shock resistance to that containing 0.03% copper. Behavior of copper-steel resembles that of nickel-steel.

CONCRETE made in cold weather should be heated during mixing. On subway work in New York, when the temperature is from zero to 20 or 30° above, a blast of distillate or gasoline is directed into the mixing machine. The subsequent 'mix' flows out warm, and sets slowly in the forms, not having a chance to freeze.

MOLYBDENITE occurs with copper at a depth of 620 ft. in the United Arizona company's mine, 32 miles southeast of Jerome, in the Copper Creek district. The mineral is found as kidneys, 4 to 18 inches thick, and assays from 2 to 30% MoS_2. A sample of this ore at this office shows massive chalcopyrite with molybdenite on parting planes.

TRINITROTOLUOL is very stable and ignites only at high temperatures, and even then it does not explode. It does not freeze, as does nitro-glycerine, and has many advantages on the side of safety and convenience. When used alone it produces large quantities of carbon monoxide; but this can be entirely prevented by combination with other chemicals, such as ammonium nitrate, if these are added in proper proportion to produce complete combustion.

SIMPLE TEST for nitrate deposits, according to B. H. Bennetts of Tacoma, Washington, is to take about one gramme of the substance to be tried, put in test-tube or other container, add a little water, about as much lye (caustic soda) as will go on the end of a pocket-knife, boil, and smell. If no odor of ammonia is apparent, add a small piece of metallic aluminum and boil. If the material contains any nitrates the odor of ammonia will be evident in a few minutes.

PRECAUTIONS to take against misfired holes are: (1) careful handling and storage of fuse; (2) careful storage of detonators in a dry place and not to keep them too long in the mine; (3) care in capping the fuses to see that no sawdust remains in the cap; (4) fasten the primer cartridge to the fuse; and (5) in blasting in wet places grease the fuse, especially at the junction of the cap, tie the paper of the cartridge tightly to the fuse, and grease the connection.

SUB-ARTESIAN WATER, amounting to 1,000,000 gal. daily, is flowing in the Edna May gold mine, Western Australia. The veins and country rock are almost impervious to water. The water met with comes from fissures caused by intrusion of many granite dikes, is under considerable pressure—80 lb. at depth of 300 ft.—and is probably derived from rain on the granitic rocks that surround the district. In the Deep Levels mine adjoining, the cracks made by the dikes and carrying the water were sealed by the cement method.

MINING methods in New York City—in new subways—vary considerably. In the sand and gravel strata, close timbering is necessary, with half sets. In hard-pan—gravel and clayey matter—a shield is used, this being pushed ahead as excavation proceeds. In rock—a schist-gneiss—ordinary drilling and blasting methods are in vogue. Mining in the city is of far greater extent than generally thought, and by the end of 1918 there will be 308 miles of subways. This does not involve excavating a small tunnel, but one the full width of a street and often wider. At the same time traffic on surface must not be interfered with by underground work. Eventually there will be 600 miles of underground lines, costing $400,000,000 in all.



NEW YORK

Financial Situation.—Sale of Chilean Nitrate Deposits; a Review of the Industry.

In view of the unsettled international situation, and prophecies of disaster from a certain section of the press if Japan were to take a more active charge of Allied interests in the Orient, the general condition may be described as one of nervous indecision. Trading in stocks and securities has been reduced in volume and Japanese bonds, in particular, have sagged. Bank clearings show an increase of about 10% over the same week last year, and this may be taken as an indication that general business expansion is taking place. The ultimate topic of conversation in financial circles is the next Liberty Loan, what rate of interest it will bear, and date of maturity. New York is vitally interested, and realizes that the success of the next issue may again be decided by the support given here. It is now known that the City came forward at the last, when the rest of the country had practically ceased subscribing to the second issue, and made its total up to $1,413,045,800, thus assuring the success of the loan. It is generally anticipated that the next issue will bear interest at 4½%; this would seem inevitable. Present market prices of the last issue indicate that buyers have already lost an equivalent to twelve months interest in depreciation. The comparatively ready sale of these bonds at par has demonstrated the patriotism of millions of subscribers, but subsequent issues must be placed at higher interest rates, and the question of increased cost to the country must be recognized. A loan that could be successfully floated at 3% would solve many a financial problem; and there is no question that this could be done with comparative ease by an issue of premium-drawing bonds. If the prejudices of the few against anything in the nature of a lottery could be subordinated to the fact that an immense saving to the country would result, the issue would soon be an accomplished fact. Consider the salient features: The loan would be subscribed with only a small proportion of the wastage of labor and money now needed to make such an issue a success. With an issue of $5,000,000,000 in 30-year bonds the saving in interest, with the rate reduced from 4½ to 3%, would amount to $75,000,000 per annum. If $25,000,000 of this were spent in premiums, to be drawn annually or semi-annually, there would be a net saving of $50,000,000 per year, or $1,500,000,000 during the life of the loan, in addition to the saving on interest and principal on bonds which may draw premiums. This scheme has been ably championed by J. W. Harriman, president of the Harriman National Bank. The figures are incontestable, and the arguments unassailable. Critics are silent. The appeal to human nature, and the recognition of the fact that even the remotest prospect of a prize will invariably insure the success of any loaning operation, will ultimately be recognized as a factor in national financing, and the premium bond will then come to stay.

The Chargé D'Affaires for Chile advertises in New York papers the sale by auction, on August 10 next, of 9,906,402,886 metric quintals of nitrate land in Chile. Fourteen lots will be offered to comprise this total, and the Government places a minimum reserve price varying from 10 to 25 centavos per quintal, averaging 23 centavos. The metric quintal is taken to equal 100 kilogrammes. Payment is to be made in gold at a standard rate of exchange of 18 pence (36 cents) per peso. The figures of 'caliche' reserves in the various plots are stated with a precision that questions verisimilitude and invites suspicion, but intending buyers may rest assured that this is merely the result of arithmetical exactness in the multiplication of approximate estimates. Those who are aware of the methods adopted in estimating the nitrate content of such ground know that the resulting figures are only approximate. As a matter of fact such estimates are a good guide to the probable quantity of caliche available, but nothing more. As regards actual nitrate content, this may be roughly estimated by considering the minimum reserve price put on the particular lot, and may vary according to the proximity of the deposit with reference to existing or future railroads. Water supply is also a factor in the estimation of market value of caliche ground. To the uninitiated, the Chilean government's method of disposing of its properties may seem strange but, nevertheless, the scheme has its good points. Intending purchasers know precisely what they are buying. The deposits are all on the surface or near it, and can be sampled cheaply with comparative ease. Checks made on the calculated contents of a lot by independent engineers will usually show that the official figures under-estimate the amount of caliche available. Such figures do not include any allowance for possible or probable deposits that may be found at depth; but should such developments occur the new reserves would become the property of the owner. Such prospects are, however, remote. If successful, the sale in August will dispose of about a billion tons of caliche. This figure suggests that some more ambitious scheme for the treatment of this material might be considered. As a preliminary it may be said that among engineers the general impression is that the proposed plant to extract nitrogen from the air, which has been under consideration for so long, will not rival or interfere with the Chilean industry in any way. The cost of producing artificial nitrate will always be high. If cheap power is available it might well be used for purposes of manufacture of material that cannot be cheaply produced from natural deposits. The cost of Chilean nitrate may be lessened in spite of frequent assertions to the contrary. A recent contributor to the **Mining and Scientific Press**, in disagreeing with this view, cited the high fuel expense necessarily involved in treatment of caliche. A parallel assumption might well be made with reference to coal requirements for New York City, but recent investigations have shown that the abolition of all the small plants and establishment of a few central power and heating stations would result in the saving of several million tons of coal annually. The same argument applies to caliche treatment. To the visiting engineer nothing in the whole scheme of operations appears so absurd and illogical as the entire lack of any idea of centralization. 'Oficinas' under the same control, and even within hail of one another, operate independently in every way. There is an unnecessary multiplication of general expenses, a waste of fuel, and an absence of any co-

ordination in research work that is lamentable. If the billion tons of caliche land now for sale contained but a fraction of its value in metal of almost any kind, the question of a plant of adequate size would receive immediate consideration. Chile has not received the attention it deserves from big corporations interested in nitrate; and yet nothing is more certain than that there will always be a brisk demand for Chilean nitrate at a reasonable price. One plant built on common-sense lines and operated on an approximate tonnage of caliche, certainly not less than 5000 tons per day and preferably twice this amount, would demonstrate that the economical production of artificial nitrate is out of the question until the existing natural deposits have been worked out; and this will take many years. The technochemical problems involved in the treatment of caliche and production of high-grade nitrate are almost negligible, although variation in composition may involve minor modifications in method in different localities. Problems to be solved to ensure a satisfactory recovery are entirely of a mechanical nature, and are far from insuperable. Lack of co-ordinated research by practical engineers is mainly responsible for the lack of progress; and a hesitancy on the part of the more conservative owners to install modern equipment is excusable and may be attributed, in no small measure, to the dubious results obtained from the installation of an up-to-date equipment of questionable applicability in the nitrate industry. Progress has also been seriously hindred by the autocratic control of all filtration patents, through an apparently weak spot in Chilean patent law, for the purpose of suppressing competition. If metallurgical engineers, who have proved their ability in those industries where wet metallurgical practice has been revolutionized by new methods in the treatment and mechanical handling of slime, could co-operate with the chemical engineers of the Chilean 'pampa' the result would be satisfactory to all concerned. At present the rival camps are far apart. The chemists hold somewhat aloof and adopt a superior and mysterious attitude, which creates the impression that the publication of some new, certain, and infallible process is imminent. The metallurgists have failed in not treating the problem from the broad engineering standpoint, and by insisting that its solution lay only in the adoption of some patented machine rather than by a modification in method in conjunction with the use of modern appliances. The writer of these notes is conversant with the subject, having been recently in Chile.

CRIPPLE CREEK, COLORADO

Myron Stratton Home Corporation.—Leasing Activities.

Cripple Creek mining companies paid $61,103 in dividends to the Myron Stratton Home Corporation during 1917, according to annual statement of the McMahon Audit Co. to the trustees. Portland company paid on 504,333 shares owned by the Corporation $60,520. The stock is valued at $756,499. Granite company paid $430, and Isabella company $153. Stratton Cripple Creek Mining & Development Co.'s report shows total receipts of $32,585, of which $26,598 was paid by lessees as royalties. Total assets of the Myron Stratton corporation are given at $7,590,342, an increase over those of 1916 by $188,605.

Four mining properties on eastern slope of Ironclad hill were loading ore by team on February 9 for consignment to the Golden Cycle mill at Colorado Springs. Shippers were Jerry Johnson, operated by Cripple Creek Deep Leasing Co.; Forest Queen, by Edwin Gaylord; Pride of Cripple Creek and W. P. H., operated by lessees.

United Gold Mines Co.'s leased properties in February yielded 2000 tons of ore worth $40,000 gross. Producers were the Trail, Bull Hill, 1435 tons; W. P. H., Ironclad hill, 315 tons; Montrose, Ironclad hill, 35 tons; Bonanza, Battle mountain, 105 tons; and Damon mine dump, Ironclad hill, 105 tons.

Lessees of the Elkton Mining & Milling Co.—four sets—produced 600 tons, averaging 1 oz. per ton, during February. Company is now driving on Raven vein from 1100-ft. level of the main shaft, through undeveloped territory to the north.

Index mine, on Gold hill, owned by Index Gold Mines Co. and under lease and bond to El Paso Extension company, will commence shipping during the coming week.

Komat Leasing Co. has resumed operations at Victor mine, Bull Cliffs, this district. Property is owned by Smith-Moffat Mines Co., whose management has modified terms in the new lease.

Teams have been busy every day this week on the clean-up shipment of Elmer Smith from the Howard shaft of the Mary McKinney mine on Gold hill. He recently sold the lease to the Victory Gold Mining Co., of which H. J. Newton, of Denver, is president.

Golden Cycle Mining & Reduction Co. paid dividend of 3c. per share, or $45,000, on March 10. This is the third monthly distribution for present year.

Rose Nicol Gold Mining Co.'s shares have been in demand the past week, 51,000 selling on March 9 at 8½c. each. A year ago they were quoted at 4c. or under. Rose Nicol is under lease to Camp Bird Mining, Leasing & Power Co. Ore has been opened on the 800-ft. level, as well as in the Roosevelt tunnel at a depth of 2100 ft. in Rose Nicol ground. Rose Nicol adjoins Portland company's Battle Mountain estate.

PLATTEVILLE, WISCONSIN

Conditions Early in March.—Ore Ranges.—New Companies at Benton and Cuba.

Operating conditions in the zinc region were better during the first half of March, enabling an output of 9756 tons of mine ore and 4841 tons to smelters. Local refiners received larger quantities of raw ore for dressing to 60%. Lead ore in reserve is 2000 tons, and producers are selling 200 tons per week, apparently by agreement. Iron pyrite shipments have increased from 500 to 1000 tons weekly. Roads did not improve much, and a storm on March 10 put numbers of plants out of commission.

Two great zinc-ore ranges traverse this field, one running from Highland on the north to a point south of the Mineral Point Zinc Works, the other crosses this near Linden, going almost north and south to the Mississippi river south of Galena, Illinois. South of Platteville, the geographical centre of the field, there are no great districts until Benton is reached. Geologists have long contended that a big connecting range ocurs in this long stretch of practically undeveloped ground, and many hold that a 'mother lode' will be found along LaFevre River valley east of Cuba. Others contend that the connection will be found south and west of Platteville. Some excellent deposits of zinc have been found east of Cuba, but within the past year several rich strikes have been made that rather confirm the theories of those partial to future development of the Cuba district. The Hercules Mining Co. is one lucky in this respect. Another is the Connecting Link Mining Co., also in this neighborhood; and the C. S. & H. Mining Co. is working profitably on considerable ore, although of low grade. The Baxter and Raisbeck mines here 10 years ago were rich producers, and farther west was the Board of Trade company. An adjoining lease known as the Little Dick was necessary to complete this company's holdings, but the management was unable to negotiate a deal, and when the line was reached the Board of Trade company

stopped work, and sold its big equipment. The range continues into the Little Dick land, which has also remained idle since that time, and attempts are being made to renew operations in this area.

Benton.—Frontier Mining Co. of Indianapolis, operating zinc-ore producers in this district, has been one of the most consistent dividend-paying companies in this field. The Calvert, Bearcat, Middie, Burr, Bull Moose, and Grotkin mines have a combined weekly output of 800 tons of 36 to 42% zinc concentrate. On Hirds No. 1 and 2 are extensive deposits of low-grade ore not being mined because of unfavorable markets. This company is developing a number of new producers in the Galena district. A report issued recently by James H. Billingsley, president of the Frontier company, shows that the labor situation is good, some attention has been given to road building, insuring open highways at all seasons of the year regardless of weather, and powder and steel have doubled in price, with hoisting cable impossible to obtain. On March 10 there was 1500 tons of zinc ore in bins at the various mines piled up on account of weather. Company employs 350 men, operates its own boarding-houses, and displays unusual solicitude for the welfare of its employees in reading and club-rooms. Sales of zinc ore are made under contract, mainly to Graselli Chemical Company.

Cuba City.—This district, better known for large shipments of high-grade refinery ore made for several years—output of National Separators & Zinc Concentrating Co. of New York—is becoming the centre of extensive developments that have great possibilities for production of mine ore. The last concern to start here is the Hercules Mining Co. of Wisconsin, with a capital of $100,000. Officers are prominent men of Dubuque, Iowa. The president is H. H. Busch. The general manager is Harry Seemiller, and underground manager is Robert Fox. Leases obtained on the Duncan and Scott farms comprise 400 acres of valuable mineral lands two miles east of Cuba City. Other leases have been secured for later development. On the Scott farm several borings made recently are all satisfactory, showing rich zinc with much lead ore. A two-compartment shaft is down 60 ft. Ore will be raised by April 1. Power-plant has been provided and a 100-ton mill will be built.

DENVER, COLORADO

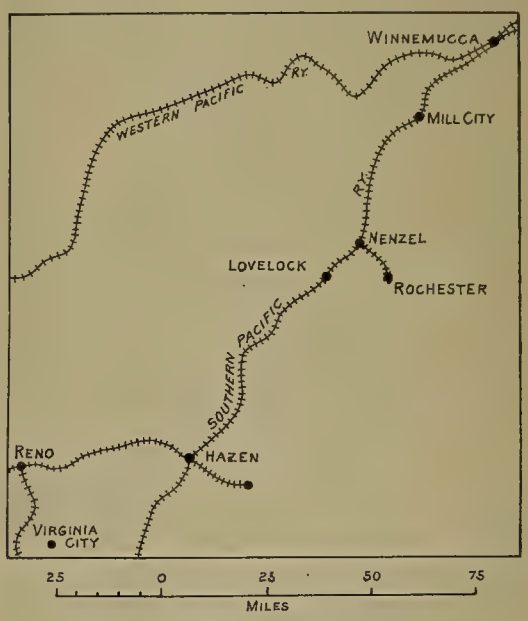
Possibilities of Developing Oil-Shale Deposits.

Oil-shale posibilities in this State are discussed by Victor A. Alderson in 'Rocky Mountain News' of March 10, although he mainly reviews work done on Scotch shales and report of David T. Day of U. S. Geological Survey on Colorado and Utah deposits. The following conclusions are deemed conservative by Mr. Alderson: (1) Production of crude oil alone from shale cannot now compete commercially with oil from flowing wells. However, the increased demand for oil, decreasing production, and steadily enhanced price on one hand will be met by an almost inexhaustible supply of oil-shale, cheap mining, improved method of distillation, and valuable by-products, which will undoubtedly, in the near future, make the oil-shale industry a strong competitor of the flowing well, and in the by no means distant future its successor. (2) Oil-shale industry is not in ordinary parlance a poor man's game. The technical and chemical problems are numerous, and require high scientific ability for their solution. (3) A plant of 500-ton daily capacity is as small as can be operated permanently and successfully, as profits will depend chiefly in large tonnage handled. In this respect oil-shale industry bears same relation to oil that Utah Copper and other great copper mines bear to copper mines in general. (4) An investment of $150,000 is as small as can be safely counted on to make a single project successful. (5) Labor is cheaper in Scotland than in the United States. The Scotch shale produces more ammonium sulphate than Colorado shale—all other elements that enter are distinctly in favor of Colorado shale. (6) Favorable features in oil-shale industry in Colorado are: (a) enormous extent of deposits; (b) great thickness both of medium and high-grade shale; (c) horizontal positions of strata and their height above the level of creeks, a combination that affords cheap mining; (d) adequate water supply for condensing and cooling-systems of both distilling and refining plants; (e) accessibility and nearness to railroads and markets; (f) richness of the shale.

ROCHESTER, NEVADA

New Tungsten District.—Nevada Packard and Rochester Mines Companies.

Mill City.—This district is fast becoming a leading tungsten producer in the country. Over 100 tons of ore, containing from 1½ to 3% WO_3 is being shipped daily. Output is increasing rapidly. L. A. Friedman's claims are the principal producers, shipping 75 tons daily. A compressor



MAP SHOWING SITUATION OF MILL CITY, NEVADA, THE NEW TUNGSTEN DISTRICT

was installed last month. The Sutton group, which was the first producer, is also putting in a compressor. It is stated that the option recently taken on the Copley, Gavin, and McFarlane claims, involving $75,000, was for W. J. Loring of San Francisco. Mines are only a short distance from Mill City station on Southern Pacific railroad. Ore is sent to a concentrating plant at Toulon. Treatment and shipping costs are about $18 per ton.

Packard.—Nevada Packard Mines Co. is treating 100 tons of $8 ore daily. Mill additions are complete and an extraction of over 91% is being made. Two-compartment winze has been started from the mill adit-level.

Rochester.—Rochester Mines Co. is treating 190 tons daily, yielding $65,000 monthly.

Lower Rochester.—Buck and Charley company is making regular shipments of silver-gold ore to Kennett smelter, California. Occasional lots are sent from the Octopus and Flunkey claims to same smelter.



ALASKA

Juneau.—Alaska Gold Mines in February produced 140,305 tons of ore assaying 93.4c. per ton. Extraction was 79.76%. January results were 179,300 tons of 90.3c. ore, and 77.85% recovery.

Kennecott.—Kennecott Copper Corporation produced 5,888,000 lb. during February. A year ago yield was 7,090,000 lb., and two years ago 9,750,000 pounds.

ARIZONA

Ajo.—New Cornelia in February produced 3,606,000 lb. copper, of which 2,522,000 lb. was in electrolytic cathodes, 538,000 lb. in cement metal, and 546,000 lb. in smelting ore.

Bisbee.—Shattuck-Arizona in February produced 854,042 lb. copper, 66,765 lb. lead, 6590 oz. silver, and 73 oz. gold.

Calumet & Arizona in February yielded 2,900,000 lb. copper, against 4,748,000 in January.

Calumet & Arizona company's central three-compartment shaft has been sunk to 600-ft. level, from which total openings amount to 2500 ft. In No. 1 cross-cut low-grade ore has been cut. Water-courses have been opened recently and will be followed.

Recently opened good ore on 1450-ft. level of the Denn-Arizona is said to be improving. Reports of a merger of this and Shattuck company are denied.

Boreas property has been shipping regularly, and developments of the last week have been encouraging to lessees.

Chloride.—Hackberry Consolidated's shaft is down 700 ft. on incline, to be sunk to 1000 ft. Vein is being followed. Company contemplates erecting a mill to treat its lead-zinc ore.

Clifton.—Shannon Copper Co. produced 788,000 lb. metal in February, against 792,000 lb. in January.

Constellation.—Arizona Copper Belt Mining Co., operating in Black Rock district of Yavapai county, is opening ground at 300 ft. depth. Some good copper-silver-gold ore has been exposed. W. J. Dilthey is president.

Globe.—Gibson Consolidated Copper Co.'s new mill is being designed by H. K. Burch. Ore shipments are over 200 tons per month. F. F. Towle is manager.

Jerome.—Mineralization is much heavier in drift No. 14 on 700-ft. level of Verde Combination, considerable pyrite appearing in the schist-porphyry contact. A winze has just been started from bottom of No. 13.

Pittsburgh-Jerome announces that encouraging showing of chalcopyrite in quartz, some 90 ft. long, has been opened on 900-ft. level.

Shea Copper Co. has opened silver ore containing 40 oz. per ton on the 360-ft. level.

Mayer.—R. C. Houston has opened rich silver ore on Pine creek in the Turkey Creek district. So far $2000 has been extracted.

Old Peck silver mine, in Mayer district, has been acquired by W. W. Williams of El Paso. Dump contains 200,000 tons of high-grade ore. This is to be treated and mine reopened.

Metcalf.—Arizona Copper Co. produced 3,600,000 lb. in February, against 2,500,000 lb. in January. Operations have not reached normal capacity since the strike. In February 1916 output was 4,600,000 pounds.

Miami.—Porphyry Copper Co. has cut a station at 500 ft. depth and is cross-cutting, while at 600 ft. a station is being cut, preparatory to driving south to Live Oak ground.

At a cost of $40,000 Inspiration Consolidated is installing an automatic block system throughout its mines. Every entrance to ore-haulage drifts will be protected by semaphores and lights, as well as every short section of the main track. The change is expected to speed up ore movement, as well as improve safety conditions.

Oatman.—Cross-cutting from 500-ft. level of Aztec in search of faulted vein of Tom Reed, has, it is reported, cut a new orebody 87 ft. wide, averaging $25 per ton.

Fifty-one feet of $15 ore is said to have been opened in eastern part of the Gold Road mine.

Cross-cut on 965-ft. level of the United Eastern is now in ore 20 ft., being similar to that on 665-ft. level. Company pays 50c. per share on March 26, equal to $68,150.

Gold Ore reports that cross-cut on 650-ft. level has opened 10 ft. of $25 ore.

Prescott.—Shannon Copper Co. paid $125,000 for Yeager Canyon mine, it is announced. Engineers state that the mine is opening well and has good possibilities. While under option $75,000 was spent in development and sufficient ore is opened to pay purchase price. Depth is 1100 feet.

Tucson.—Extension of El Paso & Southwestern railroad from Tucson to Mesa and Clarkdale, behind which is D. C. Jackling and others, is reported as likely to be started soon.

Wenden.—Activities in Bill Williams, Cunningham Pass, Sunset, and Wenden districts of Yuma county include early installation of machinery at Cactus Queen; commencement of work on manganese deposits a few miles up Bill Williams river from Cactus Queen; opening 2 ft. of rich copper-gold ore by Black Giant Mines Co., shaft-sinking, and recent erection of compressor and engine; lessees near Black Giant property are shipping regularly; and resumption of work at the Wenden copper mine. Cunningham Pass district is said to be suitable for lessees.

CALIFORNIA

Amador City.—Bunker Hill shaft is to be sunk several hundred feet deeper, in hope of developing better-grade ore. Assessment of 10c. per share has been levied to finance the work.

Auburn.—Large deposit of chrome has been discovered on ranch of Ivan H. Parker, 8 miles from here. A company is being formed to develop it.

Baxter.—Mohave United M. & M. Co., operating in San

Bernardino county near the Nevada border, reports that Eastern people have agreed to finance it. Several hundred feet of preliminary work has been done, also churn-drilling to 300 ft. Average assays of ore opened are 7% copper and fair gold and silver contents. Machinery is to be ordered at an early date. P. H. Lietzow is manager.

Bishop.—Cooper Shapley and associates of Bishop are arranging for building a concentrator at tungsten mines near Round Valley, 12 miles from Bishop. A large deposit of medium-grade ore has been developed. Some difficulty is experienced in securing equipment.

Copper City.—Shasta Belmont company is completing arrangements for early ore shipments. Road will be improved from mine to Heroult, and additional equipment installed. Ore assaying 7% copper has been opened in lower adit.

Etna Mills.—Stamp-mill at Blue Jeans mine is nearly complete. Considerable ore is said to be ready for treatment.

Forest.—A 400-ft. drainage-adit has been completed at North Fork mine. Driving proceeds steadily on fair-grade quartz. George F. Stone, the manager, is looking for a vein believed to occur deeper. Development of ore-shoot lately found near shaft will soon be started.

Happy Camp.—Platinum production of placer companies operating on Klamath and Salmon rivers is reported to be increasing.

Klamath River Dredging Co., working at Walkers bar since 1915, has acquired additional ground adjoining.

Orleans Bar.—Placer operations in this Siskiyou county district will be reduced this season owing to light snowfall in mountains. Marcussen, Reynolds Creek, and Bonaly properties are hydraulicking.

Oroville.—Western Ore Co., operating chrome claims at Lime Saddle, near here, is to erect a concentrating plant at an early date.

Redding—Bully Hill copper mines and the 15-mile Sacramento Valley & Eastern R. R. are reported to have been sold. Property has been leased to Walter Arnstein from General Electric Co. Ore is shipped regularly to the smelter at Kennett.

Trinity Center.—Estabrook Gold Dredging Co. has erected a saw-mill on Rancheria creek to cut 1,500,000 ft. of timber for its No. 2 dredge. This boat will have a hull 70 by 155 ft. Buckets are to be of 20 cu. ft. capacity. Machinery will weigh 1500 tons.

Weaverville.—Lagrange company has plenty of water for hydraulicking, keeping three giants busy day and night. Returns from this property in recent years are as follows:

Year	Gold, etc.	Operations	Interest, etc.	Dividends	Loss
1916	....$41,148	$76,097	$21,361	.....	$56,310
1915	 55,062	81,879	24,978	.....	51,795
1914	 83,627	108,435	18,764	.....	43,572
1913	122,957	100,882	12,207	$67,500	57,632
1912	151,443	96,556	17,845	52,500	15,458

COLORADO

Canyon City.—Zinc-oxide plant has recently been erected here under supervision of A. B. Augustine, who constructed a similar one at Leadville.

Central City.—Mines on Quartz hill may be drained and re-opened if local capital is procurable. The Miners' Association is considering the project.

Cripple Creek.—Cresson Consolidated reports a profit of $48,702 for January. Cash on hand, plus 25 cars of ore in transit, amounts to $1,067,357. Usual monthly dividend of 10c. was paid. Ore-reserves on February 1 were valued at $3,271,962. Ore shipped was rather poor in January. New orebody on No. 10 level is good, grab-samples assaying $40 per ton. Diamond-drilling in No. 8 shows 88 ft. of $23 ore.

Isabella Mines Co. reports 15 sets of lessees mining on Bull hill. Of these leases, nine are operated on the split-check system, one on royalty basis, and five on dumps. All lessees are doing well.

Georgetown.—Urad mine in Daily district is producing molybdenite. Forty men are employed in mine. Aerial tram 2400 ft. long carries ore to 200-ton mill. Dressing consists of ball-milling and flotation apparatus.

Leadville.—Western Zinc Oxide Co.'s plant has been operating at full capacity, 50 tons daily, for several months. There is good demand for its product by paint and rubber manufacturers. Carbonate ore is treated in the plant. J. B. McDonald is manager.

May Queen Leasing Co has blocked out a good deal of 24% zinc carbonate ore, shipping 25 tons daily to the Western Zinc Oxide plant.

Pingrey Mines Co. is busy opening its molybdenite deposit at Climax, in charge of O. A. King. Ore averages 1% MoS_2.

IDAHO

Adair.—Richmond M. M. & R. Co. reports for 1917 that shipments totaled 7766 tons of ore, assaying 6.17% copper, and 0.156 oz. gold per ton. Receipts were $292,117, less $110,650 for freight and smelting. Labor and supplies cost $84,231, leaving profit of $97,235. Dividends amounted to $84,000. On 150 and 280-ft. levels ore carries 6% copper. B. N. Sharp is manager.

Elk City.—Rich gold-silver-copper-lead ore has been opened at depth of 100 ft. in Billie Boise mine, 14 miles south of Buffalo Hump, in central Idaho. Mine is under lease to George Bancroft of Denver, Colorado.

Hailey.—Federal Mining & Smelting Co.'s North Star mill is being overhauled. In its Independence mill, a mile from the North Star, considerable 8% lead and 20-oz. silver ore has been developed.

Kellogg.—Pine Creek railroad construction is to be resumed by the O.-W. R. & N. Co. Suspension was due to difference between contractors and railroad company.

Mullan.—Federal Mining & Smelting Co. is treating 1000 tons of ore daily at its Morning mill. Mace No. 6 adit will be started again in April or May, and may be extended 1700 ft., giving a depth of 1200 to 1500 feet.

Consolidated Interstate-Callahan Mining Co. in last quarter of 1917 shipped 2299 tons of crude zinc ore and treated 31,115 tons locally. Total metal contents were 11,968,100 lb. zinc and 2,398,607 lb. lead. Costs amounted to $7.30 per ton. Profit was $233,083, less $41,158 for improvements. On No. 8 level, 7 ft. of ore assays 36.3% zinc. This was opened 120 feet.

Murray.—Miners Smelting & Refining Co. is reported as having been formed to build plant on Coeur d'Alene lake, Idaho, according to C. T. Kennan of Murray. Share-holders are to be owners of mines supplying ore to smelter. Reduction will be done at cost. All persons and mining companies owning mining claims or lands in Idaho, Oregon, Washington, Montana, and British Columbia may be shareholders in the company.

Yukon Gold Co.'s dredge on Prichard creek is working 24 hours daily. Bedrock is 30 ft. deep. Boulders have given no trouble, neither has cold weather. A. D. Hughes is manager.

MICHIGAN

Houghton.—Copper is accumulating in yards and docks due to shortage of freight-cars. Said to be enough metal to load three steamers. Navigation opens late in April.

South Lake Mining Co. reports for 1917 that income amounted to $118,824, of which $94,049 was from sale of copper. Expenses were $203,539, $195,850 being for mining. Excess of liabilities over assets is $97,076, against $2212 excess of assets a year previous. From May 1916 to December 1917, mill treated 68,388 tons of ore, yielding 754,433 lb. copper, equal to 11.03 lb. per ton. In December average was 14.5 lb., and in January 16 lb. Area of 166 acres adjoining on north is to be acquired for $90,000. To pay for this and other indebtedness stock has been offered to shareholders at $2 each.

MISSOURI

Granby.—M. K. & T. Mining Co., with C. A. Davis in charge, has resumed ore-dressing at its 500-ton mill, which has been closed by bad weather. Ore is mined at a depth of 240 feet.

Joplin.—Production of Missouri-Kansas-Oklahoma region last week was 6249 tons blende, 155 tons calamine, and 1077 tons lead, averaging $53, $35, and $86 per ton, respectively. Total value was $492,243, making $2,613,155 for 10 weeks.

Neck City Mining Co. has been organized with capital of 1500 shares at $100 par by B. C. Burgess and others of Joplin.

Hill Lead & Zinc Co. has been organized with capital of 300 shares at $100 par by H. B. Wolcott and others of Joplin.

Seneca.—Considerable activity in this part of Newton county. Okmulgee Mining Co. has an 800-acre lease of Brown land, and is to drill it. J. H. McBrayer is in charge.

Silver Crown Mining Co., in charge of J. W. Thomas, is to start work here; also the Seneca Fault Mining Co., J. R. Case, superintendent.

Wentworth.—Zinc concentrate production of Georgette M. Co.'s two mines is 50 tons daily, rivaling all others in the Joplin district. Ore carries 7 to 20% blende. O. B. Henry is manager.

MONTANA

Butte.—Revival of Butte Metal Mine Workers' Union is being attempted by T. Campbell and W. F. Dunn, two strike leaders.

Butte-Copper Czar Mining Co. held its annual meeting on March 7. New York people have financed company, taking option on 80% of shares. Sunflower and Mayflower claims adjoining were purchased, making property 42 acres. Cross-cut is being driven at 300 ft. and shaft may be sunk to 500 ft. Morton Webber is consulting engineer.

Ore-reserves in Butte Copper & Zinc Co.'s mine, leased to Anaconda company are as under:

	Zinc ore	Manganese ore
Developed, tons	140,300	30,000
Zinc, per cent	16.6	.....
Lead, per cent	6.9	.....
Silver, ounces	8.5	.....
Manganese, per cent	.....	38
Probable, tons	243,000	900,000
Zinc, per cent	15	.....
Lead, per cent	5	.....
Silver, ounces	6	.....
Manganese, per cent	.....	38

Butte Copper & Zinc Co. has closed contracts with U. S. Steel Corporation and others for 5000 tons of manganese ore. This is rhodocrosite, carrying 37% Mn and 7% SiO_2.

Elm Orlu Mining Co.'s suit for injunction restraining Butte & Superior Mining Co. from extracting ore from Rainbow vein in Black Rock claim of latter may be heard about middle of May.

Libby.—Rose Consolidated has increased capital to $200,000, shares 10c. par. Ball-mill is to be added to 10 stamps. Reserves above adit between No. 1 and 2 shafts are 3500 tons, assaying $9 gold per ton. H. H. Phipps is president, and A. I. Goodell manager.

Marysville.—Barnes-King company has opened rich gold ore in its Gloster mine, hitherto producing only low-grade material.

St. Louis company is developing Drum Lummon ground to supply a 25-stamp mill.

Saltese.—Tarbox Mining Co. is to erect a 300-ton mill in the summer, according to manager, Richard Daxon. On 800-ft. level of mine over 700 ft. of openings have been made. Property has been examined by J. F. Davey, who reports that with proper equipment profits should be made. Water-power is also to be utilized. Ore carries lead and zinc.

Warm Springs.—Mountain States company has repaired its 250-ft. shaft to depth of 50 ft., and is installing machinery.

Frank Willard group is showing 4 ft. of lead-silver-zinc ore at depth of 100 feet.

Wolf Creek.—Rich silver ore is being sacked for shipment at Silver mine. Ore was found at 250-ft. depth. Extent of ore-shoot has not been determined.

NEVADA

Battle Mountain.—C. W. Burge states that San Francisco capital will erect a smelter and concentrator at this place to treat custom ore. Forty acres has been selected for site, and work is to be started within 60 days.

Gold Top Mining Co., in charge of J. J. Graf, is to install a compressor and machine-drills. A 36-ton ball-mill is crushing gold ore, but copper has been developed in promising quantities.

Goldfield.—Conferences have been held during past week by Florence Goldfield and Red Hills-Florence companies, relative to title to rich vein lately opened by latter at a depth of 400 ft. A survey of the workings was made, E. A. Byler representing the Florence, and J. B. Witt, of the Goldfield Consolidated, the Red Hills-Florence interests. It is reported the latter company has offered to purchase the Florence mine.

Jumbo Junior winze is down 80 ft. below 880-ft. level. Ore is from 18 to 24 in. wide, assaying $100 per ton.

Ingalls mine in Tule canyon is shipping 50 tons of ore to smelter. Lessees estimate value to be $300 per ton, mostly in silver.

Luning.—Operators are increasing the study of geological conditions here, in order that useless exploration may be eliminated. In 1917, about 25,000 tons of ore was shipped from this district, mostly mined by lessees. The Calavada is down 1200 ft., and is the deepest here.

R. B. Todd Mining Company's financial statement for period May 12 to December 31, 1917, shows receipts amounting to $5451. Of this, $746 was from ore production, balance from treasury shares, etc. Expenditure at mine was $1365. Production cost $511.

Luning-Idaho Mining Co.'s report for period September 1, 1916, to end of 1917 has been issued. Receipts totaled $24,506, of which $19,442 was from treasury stock. Ex-

penditure at the mine amounted to $15,879, $10,557 being for labor. The Hahn adit was extended 340 ft., and laterals driven over 200 ft. Leached formation and some sulphides were passed through, but the adit is not deep enough to enter the sulphide zone. Indications are encouraging. The Erickson adit is in 170 ft. in leached vein matter, but with considerable oxide ore. No. 1 Stockham adit was driven 143 ft., mostly in oxide ore, with stringers of rich sulphide ore. This is the best exposure on the property. Development is to be continued and treatment plant erected.

Wall Street mine in New York canyon is producing 30 tons of shipping ore daily, and employing over 75 men.

Mina.—Western Silver Mines Co. has prepared plans for first unit of 500-ton mill. Ore carries gold, silver, and lead. Development aggregates 6000 ft. Reserves are estimated as 200,000 tons. Directors are Utah people. Benjamin F. Tibby of Salt Lake City is consulting engineer.

Old Candelaria silver mine has been acquired by Frank Manson of Western Ore Purchasing Co. from W. S. Chafey. If machinery can be found a 150-ton mill is to be erected.

Nelson.—Techatticup company recently won in a dispute with Colorado-Nevada Mining & Milling Co. in Las Vegas Court over the right to use water in El Dorado canyon. The Colorado company has appealed on grounds of new evidence. On the basis of plenty of water, Techatticup is preparing for custom work and a two-compartment ore-bin of 150-ton capacity will be ready in a month.

Crown Queen mine has recently been sampled and examined preparatory to resuming under the same management as Techatticup. Crown Queen was shut-down June 30, 1916, on account of poor ore.

Cashman, Crozier, and Irwin have just completed operations on their claim where $1500 ore was found for a time.

Allard's lease on Carnation mine is preparing for larger output. Tube-mill and centrifugal amalgamator are to be installed to treat high-grade ore.

Rand Mine & Milling Co. has shut-down its stamp-mill, due to lack of water, but is mining a small quantity of ore.

Pioche.—In suit of Virginia Louise Mining Co. v. Prince Consolidated Mining & Smelting Co., claiming damages for



trespass, Judge M. R. Averill of District Court decided that generally the facts were as stated in complaint, and awarded plaintiff $27,334.38. At one time Virginia Louise was controlled by Prince Consolidated. Latter admitted mining 1000 tons of ore, but former claimed about 1100 tons. The examination involved interesting points, such as sampling, weight of ore in place, value, and bad faith. The Judge concluded in part. "I find that the taking of ore from the Virginia Louise ground was in accordance with the attitude of the management of the Prince Consolidated company, indifference of the rights of the smaller company, reckless disregard of the directors and stockholders of that company, an arbitrary and somewhat overbearing attitude toward it. A company the size and importance of the Prince should have kept a surveyor on duty when its work was near the line of its neighbor, and its failure to do that is in itself evidence of the disregard of its neighbor's rights, otherwise abundantly shown."

Combined Metals Co. is to start flotation plant leased from Amalgamated Pioche company. E. H. Snyder is in charge.

Tonopah.—Tonopah Mining Co. is sending dump ore to its plant at Millers and mine ore to the Belmont mill at Tonopah.

Cash Boy Consolidated development in winze below 1600 ft. is attracting attention. Vein is 5 ft. wide of good shipping grade.

In Gold Mountain and Gold Reef districts, 6 miles south of Tonopah, the Tonopah Divide has opened ore for 60 ft. at depth of 270 ft. Adjoining on south, Tonopah Gold Zone is to resume development. Adjoining latter is the Tonopah Gold Reef, which is considered to have a chance to get the Divide vein. Owners of the Divide have arranged to acquire adjoining property.

Production of district last week was 10,669 tons of ore valued at $181,373, a considerable gain over previous week. Some February outputs are as follows:

Mine	Tons	Silver, oz.	Gold, oz.	Profit
Belmont	9,290	126,056	1,274	$67,633
Jim Butler	1,860	.....	....	13,071
Tonopah Mining ..	14,520	108,954	1,157	30,175

Tonopah Extension continues development of Murray vein on 1680-ft. level, where it was found last week.

Ohio vein in West End mine is 15 to 22 ft. wide, and grows in importance.

Virginia City.—Orebody discovered on 2300-ft. level of Union Con. three months ago has been cut at 2500 ft. It is same width as on 2300 and 2400-ft. levels, averaging $30 per ton. Production is $50,000 per month. Monthly dividend of 5c. per share will be paid April 1. Cross-cutting of vein from drift on 2500-ft. level has commenced.

Milling ore has been exposed at three points on the 2000-ft. level of the Con. Virginia. South of the 'Fair Jim' stope a promising vein is under development, and farther west a parallel vein is yielding ore at two points. Product is treated in Mexican mill, averaging $18 to $20 per ton. Output is to be increased. At present all ore is trammed to Union shaft from 2500-ft. level by compressed-air locomotives, but connections are being established that will permit delivery from 2000-ft. workings, where compressed-air locomotives are also in use.

Thompson.—Mason Valley smelter is reducing 1600 tons of ore daily, both furnaces in operation. Manager expects to be able to smelt 1800 tons per day in near future. Heavy shipments are coming from the Mason Valley, Bluestone, Nevada Douglas, and some small properties. Nevada Douglas contributed 2050 tons weekly and will soon increase this amount. Of the ore shipped, 40% assays 2.5 to 8.5% copper. Abundant coke supply has been secured for smelter.

Yerington.—Range of low hills west of Yerington is full of prospectors, and several leasing companies are producing steadily. Most of the ore is of shipping grade.

NEW MEXICO

Mogollon.—Erection of main mill building of Socorro plant is under way. Building material is all on the ground and deliveries of machinery have started.

Oaks Co. is installing compressor at Deep Down mine. Meanwhile development is confined to No. 3 level.

Mogollon Mines Co. is increasing output. Custom ore is being refused, due to company's own requirements.

Examinations have been made of Enterprise mine at Cooney. It is understood that this property is to be opened.

OKLAHOMA

Galena.—Pumping operations in north-east Oklahoma field has practically drained ground as far north as Galena. Deep work—285 ft.—in the Wayland mine exposed a water-course and rich zinc ore but no water had passed through for some time. L. H. Phillips of Joplin is manager.

Miami.—Property alleged to be worth $5,000,000 is subject of suit between N. S. Sherman and others and the Emma Gordon Mining, National Mining, and others. Fraud and collusion are charged, and an injunction against transfer of land is asked the court.

Picher.—Concentrate production of all districts last week totaled 3675 tons blende and 552 tons lead, valued at $239,278.

Tri-State Mine Safety and Sanitation Association, organized here some months ago, is gaining in importance. Richard Jenkins, a well-known operator at Webb City, Missouri, was recently appointed assistant secretary.

Southeast Missouri Mining Corporation has put down 31 drill-holes to depth of 185 ft., exposing ore 35 ft. thick. Two shafts are being sunk. A 300-ton mill will be completed early in June. O. C. Whitener is president.

Picher-Oklahoma Mining Co. is to erect an 800-ton mill. R. P. McReynolds is general manager.

OREGON

Ashland.—M. G. Womack, H. H. McCarthy, and Carl Jeschke, of Medford, are developing a promising asbestos deposit in Siskiyou mountains south of Ashland, which is within 5 miles of shipping. Samples show a high-grade long-fibre asbestos.

Grants Pass.—Contract has been let for erection of reduction-plant at Almeda copper-gold mine on Rogue river, 27 miles below Grants Pass. Concentrator is to be 200-ton capacity, and blast-furnace of 150-ton capacity. Cost will total $200,000. About 500 hp. will be required to operate machinery, which will be furnished by the local electric power company. Almeda mine is said to be better developed than any mine in southern Oregon; due partly to its favorable situation, being in a narrow canyon of the river, giving a natural transverse section of lode to depth of 500 ft. Development consists of 8000 ft. of underground working, consisting of 5 levels, supplemented by a 500-ft. vertical shaft. These open ore for 1000 ft. horizontally and 800 ft. vertically. Reserves are estimated to be worth $6,000,000.

SOUTH DAKOTA

Deadwood.—Gold Reward company has installed a new 100-ton Portland filter. It is used for preliminary wash of the 'blue' sulphide ore before cyaniding. Cake from filter is mixed with oxidized ore and treated by cyanide. Results are satisfactory.

Lead.—Homestake high-pressure air-compressor has been changed to electric drive, and changes from steam are also being made at Brig hoist. Other equipment will be motor driven as soon as possible. A 90-ft. raise has been started at Ellison hoist. This will have a diameter of 30 ft., lined with concrete. When completed it will be used for coal storage. The bin is connected with a lower tunnel by a chute, and coal will be transported to the central steam plant by means of conveyor-belt.

Homestake Mining Co. pays 50c. per share on March 25.

TEXAS

Benjamin.—Brazos-Wichita Copper Co., which has been conducting extensive development in this copper area, exposing a large quantity of high-grade ore, has let the contract for the construction of a smelter at Benjamin. It has been known for over 50 years that copper existed here. Metal is in the form of nodules, ranging in size from a pea to a hen's egg, found in layers in clay formation. Separation of metal from clay has been one of the most difficult problems. From time to time during many years, efforts have been made to develop this deposit. In the early 'eighties several shafts were sunk and open-cuts made, by which considerable copper ore was obtained, but the long overland haul necessary to get the ore to market made the venture a failure. In ravines and water-courses that traverse the area there were found in earlier days great piles of the copper nodules that had been separated from the clay. Several hundred tons of this copper was removed from the accumulated deposits and hauled long distances to the nearest railroad for shipment. Besides the Brazos-Wichita company, there are several other concerns operating in this part of Texas.

UTAH

Alta.—In original suit of Monetaire Mining Co. v. Columbus-Rexall Consolidated Mines Co. asking permission to use 1200-ft. level of defendant in order to reach part of its property, Monetaire company lost. In recent appeal, the Monetaire is entitled to use the level, and a new trial was ordered. Right of eminent domain was the deciding factor in the judgment.

American Fork.—All the old officers of the Pacific Gold M. & M. Co. were re-elected recently. J. L. Craig is president, James Chipman Jr., vice-president and treasurer, H. C. Johnson secretary, with A. B. Stevenson and A. K. Thornton additional directors. From February to April 1917, the mine was leased to the Fissures Exploration Co., and from that time to June 1919, by the American Fork Exploration Co. If $50,000 is not paid in royalties or otherwise by this date, the lease extends for 5 years more. So far the Pacific company has received $12,300, $3363 of which was paid during the past 11 months. Weather and strikes hindered operations during the period. Above the adit-level are 7 months' ore-reserves for the 150-ton mill.

Cisco.—Utah Placer Mining Co. is to resume work at its Beaught claim, 22 miles from this place. Plant is capable of treating 125 yards of gravel daily at cost of 24c. per yard. Gold content is said to vary from 75c. to $1 per yard.

Eureka.—Black Jack claims of Empire company are encouraging, as at depth of 1800 ft. a 3-ft. vein of good copper ore was cut recently.

Eureka King company has suspended work until more money is secured.

Gold Hill.—Western Utah Copper Co., operating in Deep Creek district, held its annual meeting at Salt Lake City on February 21. J. E. Bergh was selected as general manager. During 9 months ended December 31, 1917, metal yield was 70 oz. gold, 150,767 oz. silver, 371,418 lb. lead, and 1,710,984 lb. copper. One dividend of 7½c. per share, equal to $37,500, was paid on February 15, 1918. Shipments are now 200 tons daily.

Pole Star Copper Co. has opened shipping ore at depth of 300 ft. This has aroused interest in the district.

Park City.—Ore and concentrate shipments during February amounted to 7250 tons, against 10,547 tons in January. Weather was mostly responsible for the shrinkage. Silver King Coalition sent out 1896 tons, Ontario Silver, 1933; Judge M. & S., 1058; and Silver King Con., 796 tons.

Daly-West Mining Co.'s control has passed to Judge Mining & Smelting Co. Better results are expected from new management. No dividends paid since 1913.

Tintic.—Ore production of the district during February amounted to 16,400 tons from Eureka district, 7000 tons from Mammoth district, and 5600 tons from Silver City. Tintic Milling Co. at Silver City received over 5000 tons.

Tintic Coalition mine is to be re-opened at an early date, Frank Thornburg having secured money for this.

Tintic-Delaware is preparing its mine for steady production when roads are passable. Good lead-silver ore is ready for extraction. Andrew Madsen is superintendent.

WASHINGTON

Metaline.—Lead & Zinc Co.'s 175-ton mill, etc., is to be sold by auction on March 28 to satisfy creditors who claim $139,179.

Northport.—Electric Point Mining Co. is to erect an aerial tram of 20-ton hourly capacity costing $40,000. This will connect the main shaft and the road at Leadpoint, 2¼ miles apart. Shaft is now 700 ft. deep. Roy A. Young is manager.

CANADA

British Columbia

Ainsworth.—No. 3 adit of Florence Mining Co. shows 300 ft. of ore, 100 ft. of which assays high in lead and silver. This is at depth of 700 ft. Mill is treating 100 tons per shift. F. R. Wolfle is president.

Britannia Beach.—Howe Sound Co. has declared initial quarterly dividend of 5%, payable April 15, amounting to $100,000. Company controls Britannia Copper Mining Company.

Kaslo.—Manganese deposits of A. G. Larson of Spokane and A. J. Curle of Kaslo have been sold to Seattle people, probably the Pacific Coast Steel Corporation, for $160,000. One deposit contains, as far as opened, 9500 tons of 43% ore.

Nelson.—Consolidated Mining & Smelting Co. may erect a concentrating plant here, according to a U. S. Consular report, February 14.

Silverton.—Standard Silver-Lead company has cut several feet of good ore between No. 5 and 6 adits, at depth of 1000 feet.

MEXICO

Jalisco

Ameca.—Magistral Mining Co. has resumed operations, and is treating 100 tons of ore daily. Mill includes Marcy ball-mill, 3 K. & K. flotation machines, Dorr thickener, etc. Ore carries chalcopyrite.

Etzatlan.—Amparo Mining Co. continues regular operations and is treating 10,000 tons of silver-gold ore monthly. Tests with flotation have been satisfactory.

Magdalena.—Cinco Minas Co. is treating 500 tons of ore daily. Little time has been lost by the revolution.

Sonora

Cananea.—Greene-Cananea produced 3,960,000 lb. copper in February, against 3,130,000 lb. in January, 1,650,000 lb. in December, and 5,100,000 lb. a year ago.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

W. B. Fisher is at Austin, Nevada.

W. J. Loring is at Mill City, Nevada.

Bulkeley Wells is at Picher, Oklahoma.

J. B. Tyrrell has returned from London to Toronto.

E. Jacobs has gone from Victoria, B. C., to Seattle.

W. de L. Benedict has arrived here from New York.

J. D. Hubbard has returned to Paradise, Butte county.

W. B. Devereux Jr. is Captain of Aeronautics, U. S. Army.

E. J. Atkison has returned to California from the Amparo mine, in Jalisco, Mexico.

L. E. Grant, assistant manager for the Braden Copper Co., has returned to Sewell, Chile.

R. N. Bell, Mine Inspector for the State of Idaho, is visiting the Oklahoma zinc region.

W. R. Ingalls has been re-elected president of the Mining and Metallurgical Society of America.

John F. Coats, mining engineer to the Granby Consolidated company, is here from Vancouver.

Samuel H. Dolbear has been summoned to Washington for consultation with the War Industries Board.

George H. Short, representing the Grasselli Chemical Co., is investigating the chrome deposits of California.

Frank W. Spear, of Las Vegas, Nevada, who is interested in the Chicago-Nevada Eldorado Co., is at Chicago.

Curtis H. Lindley has gone to Washington to argue the Jim Butler v. West End case before the Supreme Court.

Clyde M. Becker has enlisted as Army Y. M. C. A. Secretary for home service with headquarters at Camp Cody.

Charles Wright has been appointed manager of the Keweenaw copper mine, Houghton, in place of **William Uren.**

Charles R. Van Hise represented the University of Wisconsin at the semi-centenary of the University of California.

L. D. Ricketts is attending the semi-centenary of the University of California as a representative of Princeton University.

James Park, professor of mining in the University of Otago, New Zealand, is examining molybdenite properties in Queensland, Australia.

T. T. Read, of the New Jersey Zinc Co., is going to Washington to work in a newly-organized planning division of the Ordnance Department.

A. B. Richmond will take charge of the Reiniger-Freeman operations at San Xavier, Arizona, succeeding **Robert J. Ward,** who is now foreman.

W. J. Turner, smelter superintendent for the Braden Copper Co., Chile, has joined the American army. **W. L. Stevens** is now acting superintendent.

Gomer P. Jones, resident manager for the Hedley Gold Mining Co., has returned to Hedley, after undergoing a successful operation at Vancouver, B. C.

W. Sinclair Brown, metallurgist to the Redjang Lebong company in Sumatra, passed through San Francisco on his way to Glasgow, to engage in patriotic service.

Will H. Coghill, of the U. S. Bureau of Mines, will deliver a series of lectures on the 'Molecular Physics of Flotation' from March 25 to 29 inclusive at 4 p.m. each day in the College of Mining of the University of California.

F. A. Fahrenwald, consulting mining engineer and metallurgist, of Cleveland, Ohio, will be in the West from about March 25 to May 10, two weeks in New Mexico and Arizona, two in California and Nevada, and the remainder of the period in the North-West.

THE METAL MARKET



METAL PRICES

San Francisco, March 19

Aluminum-dust (100-lb. lots), cents per pound	90
Aluminum-dust (ton lots), cents per pound	80
Antimony, cents per pound	15½
Antimony (wholesale), cents per pound	13½
Electrolytic copper, cents per pound, in carload lots	23½
Electrolytic copper, cents per pound, in small quantities	24⅝
Pig-lead, cents per pound	7½— 8⅛
Platinum, soft and hard metal, respectively, per ounce	$108— 116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	10
Zinc-dust, cents per pound	17½

ORE PRICES

San Francisco, March 19

Antimony, 45% metal, per unit	$1.10
Chrome, 34 to 40%, f.o.b. California, cents per unit	60— 70
Chrome, 40% and over, cents per unit	90—105
Magnesite, crude, per ton	$8— 10
Manganese, 40%, f.o.b. Chicago, cents per unit	83
Tungsten, 60% WO_3, per unit	$24
Molybdenite, per lb., 85% MoS_2	$2.15

The tungsten market is quiet, due to transportation difficulties.

Above quotation for molybdenite is only nominal, as the principal buyers are out of the market. Japanese is being offered at large concessions.

Calcined magnesite is quoted at $35 per ton, f.o.b. shipping point.

Refractory ore and brick market is discussed in 'The Iron Age' of March 7. Price of magnesite brick has been reduced from $135 to $125 per ton, due to better railroad conditions. Chrome situation is considered serious, owing to shortage of ore and winter affecting mining operations.

Wolfram prices in Australia are $12.60 per unit for 65% ore, as fixed by the Commonwealth government.

EASTERN METAL MARKET

(By wire from New York)

March 18.—Copper is quiet. Lead is dull and easier. Spelter is inactive and week. There are no quotations for platinum.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Mch. 13	86.50	Feb. 5	86.62
" 14	86.50	" 12	85.93
" 15	86.50	" 19	85.48
" 16	86.50	" 26	85.30
" 17 Sunday		Mch. 5	85.12
" 18	87.00	" 12	85.66
" 19	87.25	" 19	86.71

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68 51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

Currency reform of China consists of two main parts: (1) unification of silver currency, and (2) redemption of depreciated notes. Fineness, weight, and form of silver coins are to be uniform, and any coins in circulation will be withdrawn and re-coined. Silver subsidiary coins to replace the small ones now in use are to be made. To do this a large sum of money must be borrowed. The 'Far Eastern Review' hopes to see currency reform at no distant date.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Mch. 13	23.50	Feb. 5	23.50
" 14	23.50	" 12	23.50
" 15	23.50	" 19	23.50
" 16	23.50	" 26	23.50
" 17 Sunday		Mch. 5	23.50
" 18	23.50	" 12	23.50
" 19	23.50	" 19	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27 42	....
Mch.	26.65	36.00	....	Sept.	28.28	25 11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Nichols Copper Co., which has a great refinery at Laurel Hill, New York, is reported to have increased refining charges 33⅓%.

Australian copper production is to be bought by the British Ministry of Munitions to June 30, 1918. Sum involved will be £2,150,000. Maximum quantity to be delivered under this contract is 20,000 tons, and the minimum 15,000 tons. Price for electrolytic and Wallaroo copper is £108 per ton (23.1 cents per lb.), and £106 (22.7 cents per lb.) for other brands, f.o.b. Sydney. Copper Producers Association accepted the offer on February 6.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Mch. 13	7.25	Feb. 5	7.00
" 14	7.25	" 12	7.00
" 15	7.25	" 19	7.08
" 16	7.25	" 26	7.10
" 17 Sunday		Mch. 5	7.33
" 18	7.25	" 12	7.25
" 19	7.25	" 19	7.25

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Mch. 13	7.75	Feb. 5	7.87
" 14	7.75	" 12	8.00
" 15	7.75	" 19	8.00
" 16	7.75	" 26	8.00
" 17 Sunday		Mch. 5	7.91
" 18	7.75	" 12	7.79
" 19	7.75	" 19	7.75

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85 00	....

Tin imports to February 28 amounted to 7740 tons, compared with 10,623 tons in the two months of 1917. Straits shipments fell off 2531 tons, and from Banka and Billiton 1260 tons.

Tin business of Hongkong in 1917 was briefly as follows: Stocks on hand, at beginning, 3600 tons; stocks at close, 1500 tons; exports to China and Japan, 1500 tons; to Europe, 2000 tons; to United States, 7158 tons. Of course this great port is only a transfer point for tin, none being produced there.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date	Week ending		Mch. 5	110.00
Feb. 19	115.00		" 12	115.00
" 26	115.00		" 19	115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	.....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	.....
Mch.	219.00	113.75	.....	Sept.	75.00	112.00	.....
Apr.	141.60	114.50	.....	Oct.	78.20	102.00	.....
May	90.00	104.00	.....	Nov.	79.50	102.50	.....
June	74.70	85.60	.....	Dec.	80.00	117.42	.....

Mexican virgin metal is readily obtainable at $115 per flask, ex warehouse, New York.

Eastern Metal Market

New York, March 13.

There has been little change in the general condition of the markets since a week ago; they are all practically devoid of interest and are inactive, excepting tin.

Higher fixed prices for copper are being urged.

Tin is in good demand for future delivery, but spot metal is still unobtainable.

Lead is less active, but the tone is firm.

Zinc is lifeless and weaker.

Antimony is lower.

The absorbing topic in steel circles is the revision of the fixed price-schedule due April 1. On Wednesday, March 20, a conference on this matter will take place in Washington between steel-makers and the War Industries Board. The diverse interests of the small producers, who must have a high price, and the largest integrated companies, who can go on the present basis, are now sharply accentuated. Pig-iron and steel output is increasing, due to more favorable weather; but the 1918 production will probably not equal that of 1917. Government requirements for the last half of 1918 are developing. For shell-steel probably 2,500,000 tons is the estimated need, compared with 1,500,000 tons in the first half. The Government also soon will buy 150,000 cars and 2500 locomotives.

COPPER

The principal topic in copper circles is the recognition that a strong attempt is on foot to advance the present Government price of copper of 23.50c. to at least 25c. per lb. by June 1, when the present arrangement expires, or before if possible. It is contended that costs of production have advanced in many departments several cents per pound, and to maintain top production a higher price for the metal is necessary. Opinion among dealers in New York varies, some agreeing that a re-adjustment is necessary, others contending that it is not, and that it would be unfair. Transportation conditions are better everywhere, and it is estimated that the output of the smelters by the end of March will be at the rate of 200,000,000 lb. per month. Added to this is the fact that imports of raw metal are increasing; those for 1918 will probably approximate 23,000 to 25,000 tons per month, contrasted with 20,000 tons per month in 1917. The Mexican output will probably be large, as well as that from other foreign sources. The fixed prices in the London market continue unchanged at £125 for spot electrolytic, and £121 for futures, which have ruled many months. Copper exports for February, to the 20th, were 18,834 tons, so far reported.

TIN

There has been a good demand during the past week for tin for future delivery but spot metal of all grades is as scarce as ever. For futures, sellers have been few and some have withdrawn from the market entirely. The result has been that buyers have bid up the market on themselves so that future shipment from the East has sold as high as 75c. per lb. In the last few days there have been no offers of future Straits tin from England. Some buyers have desired to purchase, but there have been no sellers. An unusual condition developed yesterday (March 12) which, in the memory of a large dealer in New York, has never occurred before, namely, it was impossible on that day to obtain a price of Straits tin for any position. There exists now an annoying delay in cablegrams, which is interfering with business. It takes four days to send a message over and get a reply. Arrivals to March 12, inclusive, were 997 tons. On that day the quantity afloat was reported as 6300 tons. The London market is higher than last week. Spot Straits was quoted yesterday at £322 10s., against £319 per ton a week ago.

LEAD

There is little to say about the lead market. The tone is firm and steady, but demand has lessened considerably. There has been no change in prices. Lead for early delivery is held at 7.25c., New York, by both the American Smelting & Refining Co. and by independents. The St. Louis price is 7.10c. per lb. There is very little demand for spot lead, even less than a week ago. One dealer reports no demand at all, while another sold spot lead at 7.87½c., New York, in the last day or two. The spot market is quoted at 7.50 to 7.75c., New York. Transportation conditions are much better, this being one cause of the easier market. The trade as a whole is 'watchfully waiting', and exhibiting no anxiety.

ZINC

The only strong feature of the zinc market is the demand for grade A. This is considerable, for it is the principal kind of metal that the Government needs for munitions. The supply of this is now about balanced by the demand. While the output is large, this has been partly because of the redistilling of lower grades, such as prime Western. A scarcity of grade A is not unlikely before long, on account of probable large Government munition orders in the near future. The price for grade A is fixed at 12c. per lb. So far as prime Western is concerned the market is flat, despite the estimate and probability that smelters' output has declined to 50% of capacity. Demand continues light. Sales have comprised only small lots here and there. Some of them have gone at as low as 7.50c., St. Louis, or 7.75c., New York, which seems to be the market for early delivery. Part of the sales at this low level have been for cash, which, however, is not customary. Some producers and dealers refuse to quote under 7.62½c., or even 7.75c., St. Louis. Sheet-zinc is quoted at the official price of 15c. per pound.

ANTIMONY

The market is quiet, demand outside the Government being negligible. The metal has sold during the past week at 13.25c., New York, duty paid, which seems to be the present level.

ALUMINUM

Since the Government price was fixed last week at 32c. per lb. for No. 1 virgin metal 98 to 99% pure, for 50-ton lots, there have been no developments. Quotations for smaller lots are unobtainable in the absence of official news.

ORES

Antimony: Buyers would pay about $1.75 per unit, but there is not much ore being offered, shipping conditions interfering with transport from South America.

Molybdenum: In the absence of any demand from large buyers the market is difficult, or practically impossible, to quote. Offerings of Japanese ore at concessions are not attracting any attention, according to one dealer.

Tungsten: High-grade scheelite has sold at $24.50 per unit in 60% concentrate, against $26 formerly. This is for spot delivery. The market has been generally quiet, however. Because of embargoes and the urgent need of ore by certain works, shipments of carloads have been made by express. Ores in general range from $20 to $24 per unit, depending on the grade. Ferro-tungsten is unchanged at $2.25 to $2.35 per lb. of contained tungsten.

Company Reports

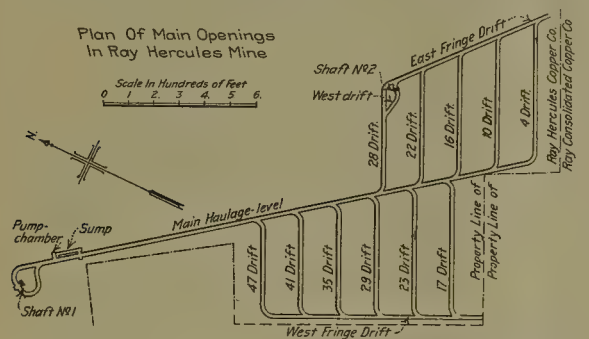
RAY HERCULES COPPER CO.

PROPERTY: disseminated copper deposits adjoining Ray Consolidated at Ray, Arizona, well developed, and a 1500-ton mill ready for ore treatment.

OPERATING OFFICIALS: C. E. Addams, general manager; J. M. Callow, consulting metallurgist; Bradley, Bruff & Labarthe, construction engineers.

FINANCIAL STATEMENT: for period from beginning of operations to October 31, 1917, shows that at the end of June 1917, cash amounted to $544,679. Company owns nearly 100% of shares in Arizona Hercules Copper Co. As production is to commence early in 1918, the next report will show revenue and expenditure items.

DEVELOPMENT: No. 1 shaft, 15 ft. 10 in. by 8 ft. 10 in. over all, is 862 ft. deep, and is to be sunk to 930 ft. By October 31, 1917, 1600 ft. of driving had been done from this shaft. Drifts are timbered with 12 by 12-in. lumber. Carbonate ore was cut at depth of 55 ft. continuing to 75 ft.; then again at 255 ft.,



continuing to 385 ft. No. 2 shaft, 15 ft. 4 in. by 8 ft. 8 in. over all, is 543 ft. deep. At 521 ft. the main haulage-level was started. From this shaft 2300 ft. of work was done to end of October. Sulphide ore appeared at 225 ft., continuing to 345 ft. From haulage-drifts of both shafts, laterals are being driven under the present developed orebodies. Reserves are estimated at 9,500,000 tons of 1.77% ore.

Tracks on main levels are of 45-lb. steel rails, 18-in. gauge, and on laterals, 35-lb. rails. Ore-cars are hopper-bottom, automatic dump, of 38 cu. ft. capacity, drawn by four-ton Westinghouse locomotives driven by 125-volt direct-current motors. Such locomotives are an innovation for underground work.

Reinforced concrete bins of 400 tons capacity each were constructed on No. 1 and 2 levels of No. 1 shaft.

NEW PLANT: At main hoisting-plant the head-frame is of steel, 110 ft. high. It carries two 120-in. sheaves for main haulage ropes. Automatic skips will carry five tons of ore. Main electric hoist has two drums, 7 ft. diameter by 72-in. face, each grooved for 1250 ft. of 1⅛-in. rope. Capacity is 300 tons per hour. Nordberg is the maker. An Ingersoll-Rand, Rogler type, air-compressor of 3000 cu. ft. capacity is at work. Complete shops are in operation.

Coarse-crushing plant contains one No. 8 Gates type K crusher and one set of 54 by 26-in. Traylor rolls. Each crusher can reduce 150 tons per hour to 2½-in. size, rolls corresponding. Product is carried on 36-in. belt to sampling-plant and main ore-bin of 5000 tons capacity.

From bin, ore is loaded into railroad cars and taken to the mill, six miles from the mine on the Gila river, at a place called Belgravia. Here is a power-house containing three Diesel engines made by McIntosh & Seymour. Each has 6 cylinders and has a capacity of 1045 hp., using 0.64 lb. of 16 gravity oil per kilowatt-hour. Each engine is direct connected to a 900-kw. General Electric generator. Transmission-line to mine is nearly six miles long.

At the mill the main bin holds 2500 tons. A Merrick weightometer records continuously the ore carried on three 16-in. belt-conveyors, which deliver direct to three No. 86 Marcy mills of 500 tons capacity each. There are also three 6-ft. Hardinge mills. Ore-dressing is done by 12 roughing and 3 finishing Overstrom tables, 9 Dorr classifiers, and 36 roughing and 6 cleaning Callow flotation cells. Two 26 by 36-in. Boston type Connersville blowers serve the flotation plant. Concentrate will be dried by three 11 ft. 6 in. by 8 ft. Oliver filters. Capacity of mill is 1500 tons daily, giving a recovery of 80%. Tailing area can easily hold 100,000,000 tons of residue.

TONGKAH HARBOUR TIN DREDGING CO.

PROPERTY: tin-dredging concession of 5350 acres in harbor of Tongkah, Puket, Siam. Five boats are operating.

OPERATING OFFICIALS: E. T. Lewis, general manager; A. McEwan, secretary.

FINANCIAL STATEMENT: for years ended September 30 are as follows:

	1917	1916	1915
Revenue	£144,845	£114,993	£123,260
Net profit	67,923	40,808	40,336
Dividends	37,500	60,000	22,500
Total dividends	.....	345,000	.....

SUMMARY OF OPERATIONS:

	1917	1916	1915
Ground dredged, cubic yards.	3,682,550	3,363,750	2,968,600
Average tin content, cents...	18.86	16.40	19.92
Cost, cents	8.80	9.26	10.00
Tin oxide (70% metal), tons.	1,188	1,076	1,262

Output to date is 9767 tons of oxide, valued at £1,026,000.

CONSOLIDATED INTERSTATE-CALLAHAN MINING CO.

PROPERTY: zinc-lead claims in Coeur d'Alene region, Idaho.

OPERATING OFFICIALS: C. W. Newton, manager; D. F. Haley, consulting engineer.

FINANCIAL STATEMENT: for 18 months ended December 31, 1917, income from ore and concentrate was $4,117,597, plus $62,335 from sundries. Operations, improvements, etc., cost $1,854,055, leaving a profit of $2,325,876. Surplus at June 30, 1916, was $783,509 net, making $3,109,386 available. After paying dividends, surplus at end of 1917 was $551,941.

DIVIDENDS: $2,557,445 was paid during the period, making a total of $6,509,860 since April 1915, or 140% on the par value ($10) of shares.

DEVELOPMENT: covered 9816 ft., and 60,000 cu. ft. of stations and skip-chutes. The 3-compartment shaft was completed to No. 8 level, 850 ft. below main, or No. 4, working adit. Shaft is being continued to No. 9 level. A fine orebody was developed on No. 7, and No. 8 has opened the same high-grade ore. Reserves above No. 7 are estimated at 310,000 tons.

PRODUCTION: there was delivered to mill 226,281 tons of ore. Of this, 17,315 tons, assaying 48% zinc, and 3335 tons, assaying 47% lead and 18 oz. silver, was shipped direct. Mill treated 186,441 tons, averaging 23.4% zinc, 6% lead, 2.3 oz. silver, and 6% iron.

COSTS: mining and milling were $5.901 per ton mined, and of shipping product, f.o.b. cars at rail, $14.13 per ton.

IMPROVEMENTS: a contract was made with Minerals Separation for installing its apparatus; adjoining property was acquired; buildings were erected; grinding department was enlarged; a cable-tram to reclaim tailing was installed; and considerable research was done.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

ECONOMY IN PULVERIZED COAL

In view of the present coal-shortage and the high cost of fuel, the results secured in a recent 24-hour test of a 150-hp. Brownell horizontal return-tubular boiler, at the demonstrating plant of the Powdered Coal Engineering & Equipment Co., Chicago, when fired with powdered coal, is of special interest to those developing steam with coal. The duration of the test was exactly 23¼ hr., and on both days, December 27 and 28, 1917, the temperature outside averaged about zero Fahrenheit. Members of the Chicago City Smoke Inspection Bureau, the City Efficiency Engineer, as well as representatives of several public utility corporations, steam railroads, and the technical press, were in attendance. The boiler furnace was served by two 12-in. Pruden coal carbureters. The conditions of the test were such as correspond to regular work, and not to special engineering refinements.

The coal burned was a high-ash (22.09%) La Salle county, Illinois, screening, with a heating value of 10,158 B.t.u. on a dry basis. The coal was dried and pulverized in the demonstration plant of the Powdered Coal Engineering & Equipment Co., this coal-preparation unit having a capacity of 60 tons of pulverized fuel per day. As burned under the boiler, the coal dust had a moisture content of 2.94%. A screening test showed that 98.8% passed through a 100-mesh screen and 90.5% through a 200-mesh screen.

The proximate and ultimate analyses of the coal are given in Table I.

TABLE I

PROXIMATE ANALYSIS

	Dry	As burned
	%	%
Moisture	....	2.94
Volatile matter	37.61	36.49
Fixed carbon	36.51	35.42
Sulphur	3.79	3.71
Ash	22.09	21.44
	100.00	100.00

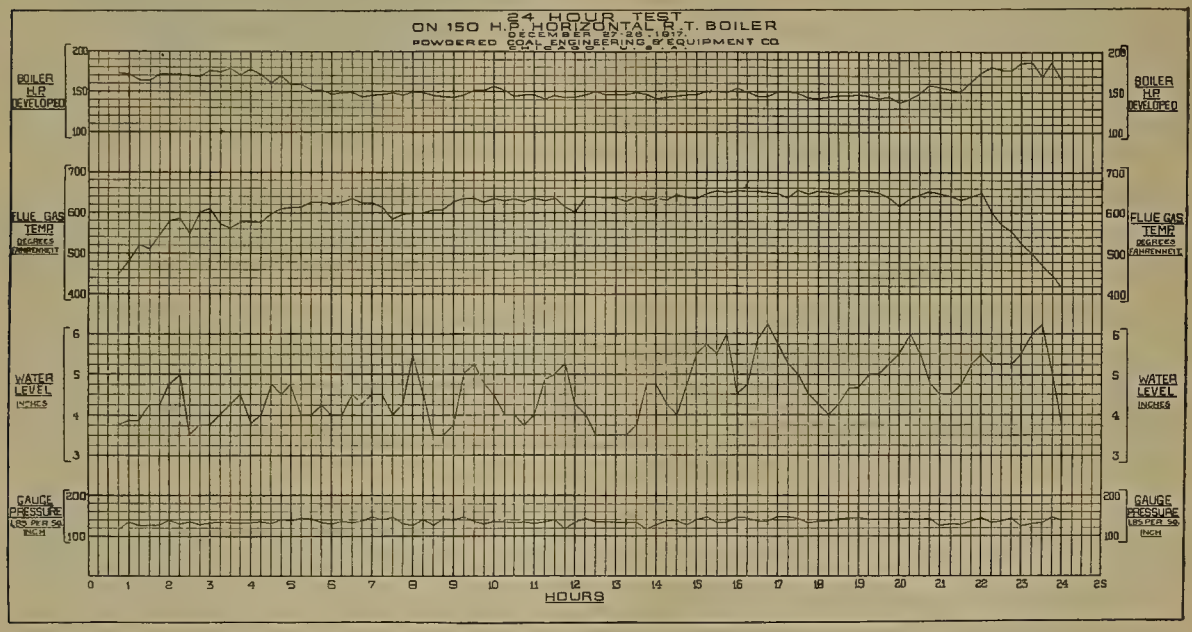


FIG. 1. CARBON DI-OXIDE CHART, 24-HOUR TEST, BURNING POWDERED COAL

ULTIMATE ANALYSIS

	Dry
	%
Carbon	60.86
Hydrogen	4.32
Nitrogen	0.99
Oxygen	7.95
Sulphur	3.79
Ash	22.09
	100.00

In Table II are given the results and data of the test, in the short form of the A. S. M. E. code of 1912.

TABLE II

DATA AND RESULTS OF EVAPORATIVE TEST

1.	Test of Brownell tubular boiler, at the plant of the Powdered Coal Engineering & Equipment Co., 2401 Washington boulevard, Chicago, to determine evaporation.	
2.	Kind of furnace	Special construction
3.	Grate-surface	Grate absent; fired by two Pruden carbureters, 12 in.
4.	Water-heating surface	1504 sq. ft.
5.	Superheating surface	None
6.	Date	December 27–28, 1917
7.	Duration	23¼ hr.
8.	Kind and size of coal	LaSalle county, Illinois, screening, pulverized 90.5%, through 200-mesh; 98.8% through 100-mesh

AVERAGE PRESSURE, TEMPERATURES, AND OTHER ITEMS

9.	Steam-pressure by gauge	135.1 lb.
10.	Temp. of feed-water entering boiler	145°F.
11.	Temp. of escaping gases leaving boiler.	609.8°F.
12.	Force of draft in fire-box	0.15 in.
13.	Per cent of moisture in steam	0.95

TOTAL QUANTITIES

14.	Weight of coal as fired	17,625 lb.
15.	Per cent of moisture in coal	2.94
16.	Total weight of dry coal consumed	17,107 lb.
17.	Total ash and refuse	3,679 lb.
18.	Per cent of ash and refuse in dry coal	22.09
19.	Total weight of water fed to the boiler	117,835 lb.
20.	Total water evaporated, corrected for moisture in steam	116,715 lb.
21.	Total equivalent evaporation from and at 212°	129,554 lb.

HOURLY QUANTITIES AND RATES

22.	Dry coal consumed per hour	735.7 lb.
23.	Dry coal per sq. ft. of grate surface per hour	....
24.	Water evaporated per hour, corrected for quality of steam	5,020 lb. per hr.
25.	Equivalent evaporation per hour from and at 212°F	5,572 lb. per hr.
26.	Equivalent evaporation per hour from and at 212°F., per sq. ft. of water-heating surface	....

CAPACITY

27.	Evaporation per hour from and at 212° F.	5,572 lb.
28.	Boiler hp. developed	162
29.	Rated capacity, in evaporation from and at 212°F. per hour	5,175 lb.
30.	Rated boiler hp	150
31.	Per cent of rated capacity developed	108

ECONOMY RESULTS

32.	Water fed per pound of coal fired	6.69 lb.
33.	Water evaporated per pound of dry coal.	6.84 lb.
34.	Equivalent evaporation from and at 212°F. per pound of dry coal	7.59 lb.
35.	Equivalent evaporation from and at 212°F. per pound of combustible	9.73 lb.

EFFICIENCY

36.	Calorific value of 1 lb. of dry coal	10,158
37.	Calorific value of 1 lb. of combustible	13,039
38.	Efficiency of boiler, furnace, and grate.	72.5%
39.	Efficiency of boiler and furnace	72.5%

COST OF EVAPORATION

40.	Cost of coal per ton of 2240 lb. delivered in boiler room (including drying and pulverizing)	$4.28
41.	Cost of coal required for evaporating 1000 lb. of water from and at 212°F.	$0.2793

Fig. 1 is a reproduction of the CO_2 chart obtained over the period covering the duration of the test. It will be observed that the CO_2 content is much higher than the average in the usual standard practice. It is certain that such a chart has never before been obtained in any type of steam-boiler practice over such a long period of time, under operating conditions that are normal and that can be duplicated by ordinary labor any day in the year.

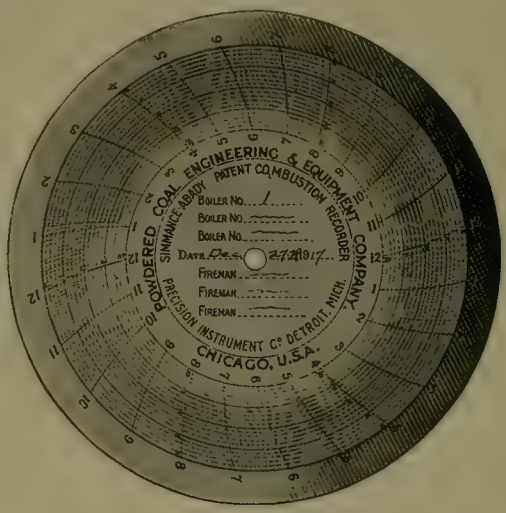


FIG. 2. SIMMANCE-ABADY COMBUSTION RECORDER

The conditions under which the test was made were unfavorable from the standpoint of thermal efficiency, making it appear probable that under continuous service in ordinary weather the high boiler and furnace efficiency, namely, 72.5%, easily might be exceeded. The powdered coal was lighted under a cold boiler three hours before the test was started, the average temperature of the air fed with the powdered coal being approximately 4° F.

Bituminous coal, with 18% ash, under ordinary conditions of grate-firing, will usually be found to produce an ash containing from 16 to 18% of combustible. The ash and slag produced in the test given above contained only a trace of combustible, actually less than 0.1%. It is evident, then, from a consideration of the unavoidable losses in grate-fired practice due to unburned material, that the burning of powdered coal by the carburization process represents a saving in this instance of $0.17 \times 0.22 \times 10{,}158 = 380$ B.t.u. per pound of coal, or a saving of 3.74% of the heating value of the coal, due only to the fact that the coal is completely burned.

It may be affirmed that the average modern plant, using the same grade of coal, would not, under ordinary operating conditions, realize a boiler and furnace efficiency of more than 55 to 60%, as against the efficiency of 72.5% that was obtained with powdered coal. Every precaution was taken to insure accuracy. Horse-power developed was recorded by a General Electric flow-meter; water evaporated checked by weighing water delivered; percentage of CO_2 in flue-gases recorded by a Simmance-Abady combustion recorder, checked at intervals by analyses in the Orsat apparatus; and the flue-gas temperature measured by a recording thermo-couple.

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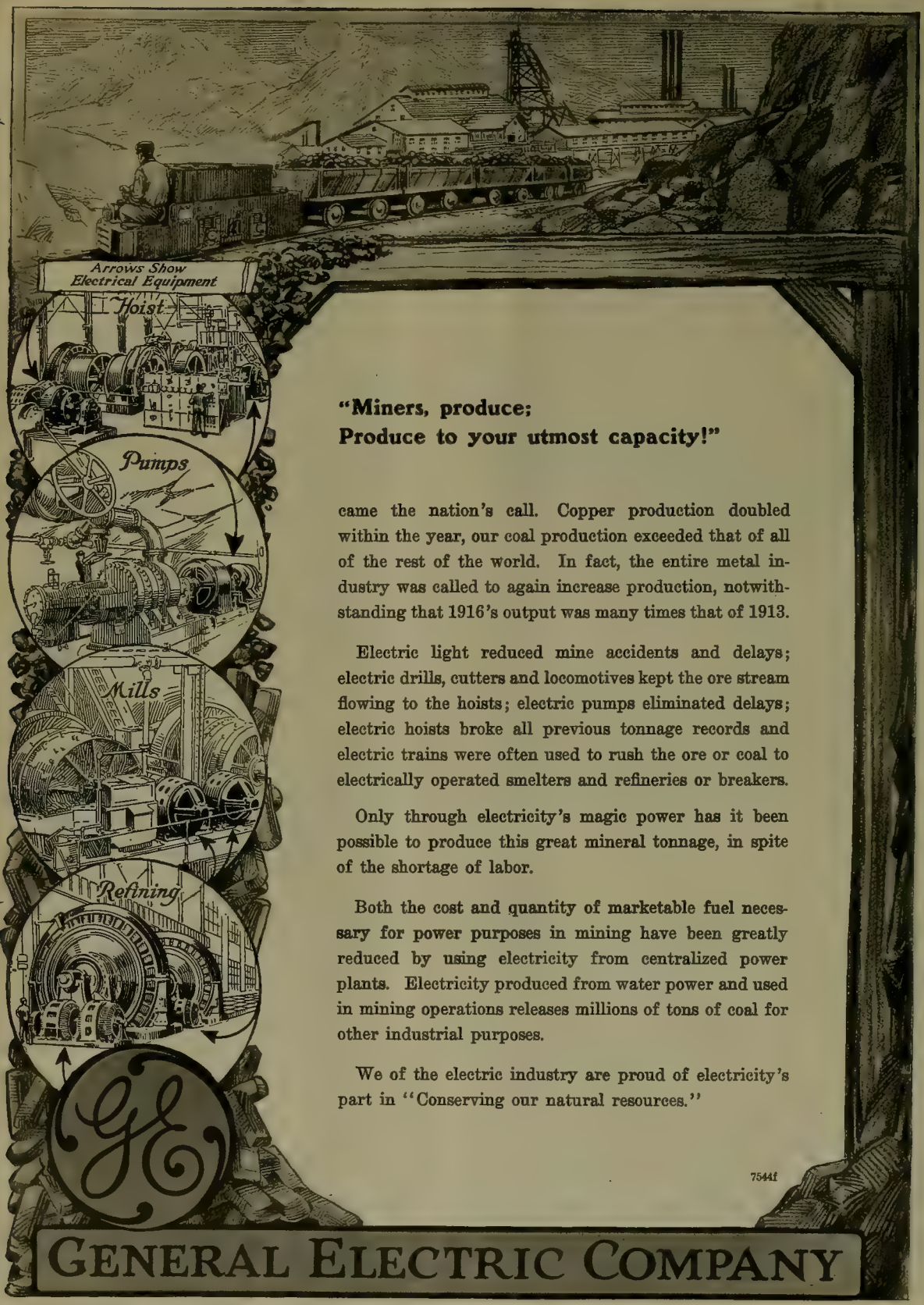
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EDITORIAL

OUR homage—our enthusiastic respect and profoundest gratitude—goes forth to the gallant men that are fighting for us at the front of battle. May they be sustained by the traditions of the English-speaking peoples, and of the French, to the full accomplishment of their devoted purpose.

AGAIN the Hearst press has shamed itself by commercializing the emotional stress of the moment by sensationalism, searing the souls of good citizens by flaring headlines that exaggerated the first news from the front. On the Monday morning Hearst's organ of misinformation could find no time to publish a thoughtful editorial on the one subject of the hour; all it could do was to give its readers a scholarly, scientific, and absorbing article on the local distribution of milk!

QUOTATIONS for silver have risen sharply during the past week. At the time of writing the New York price is 92⅞ cents, but the actual selling price in San Francisco is three cents higher. The impending legislation for coining the stock of silver in the Treasury and the demand from the Orient are the causes of this rise. It is estimated that 1,500,000 ounces is bought weekly in London for the Allies and for India. About 8,000,000 ounces is being exported weekly from the United States. If the minting of the $200,000,000 of silver in the Treasury is legalized, followed by purchase of the metal to take its place, we may expect a stable price at about a dollar per ounce.

WHAT share university men in England are taking in the War is indicated by the figures quoted by the Archbishop of York on the occasion of his recent visit to Harvard. He said that the number of undergraduates at Oxford had decreased from 3200 to 300, while at Cambridge the reduction was from 3600 before the War to 400 at the present time. Such students as are in residence now consist of those that have been rendered unfit for service by reason of wounds or previous physical disability. The college-buildings are being used for the purposes of the War. "The home of lost causes" has given her life-blood in behalf of the Cause to which we also are committed, and our own universities now are following the noble leadership of the older centres of learning across the Atlantic. By this personal devotion to a common purpose there will be forged links of friendship stronger even than the common language and the common tradition of the Anglo-Celtic race.

THAT the Germans intend to despoil France of her iron resources, if they can, has been indicated recently by the disclosure of a communication sent to Vienna from Berlin outlining the German plans for annexing parts of Russia and France. Excerpts from this official document were read by Herr Hugo Haase, leader of the Independent Socialists, before the committee of the Reichstag. France was to lose Briey and a strip of territory west from Luxembourg covering the iron deposits. These iron deposits and the Valenciennes coalfield constitute the industrial backbone of France; yet the Germans talk about a war of defence! No, it is a war by them for the despoiling of their neighbors and such domination as they can win by aid of that "good German sword" which does not scruple to kill anything—man, woman, or child—that stands in the way.

WE are pleased to record the birth of a new mining paper, which has the distinction of being the first one to be published in a country that was a producer of copper, and tin, and gold even before there was a Roman Empire. We refer to Portugal, and to the 'Revista Mineira e Metalurgica,' edited by Senhor A. Xavier da Fonseca, at Viseu. The enterprise starts modestly as a neatly printed folio of four pages, with articles on platinum and wolfram, both of which are found on the river Douro, and with other discussion of value. It is a good beginning, and the periodical will doubtless prove useful. The editor announces that it will be an accepted organ for the early publication of the discussion at the meetings of the Portuguese Miners' Association and of the Society of Civil Engineers. He also promises correspondence from mining centres in Brazil and Africa.

GREAT BRITAIN has increased her national debt from 708 to 5525 million pounds since the War began. These sums seem overpowering until one recalls the fact that her annual income is 2200 millions and her total wealth, before the War, 15,000 millions of pounds—not dollars. To lose a couple of year's income is unpleasant but not crushing to a man of vigor and resources. To lose a third of one's wealth is depressing, but not

fatal, provided the power of recuperation persists. The British people are bearing a daily expenditure, on the War, of $32,000,000. They have raised £4,200,000,000 since the War began and they have loaned £1,100,000,000 to their allies. The larger unit of the pound sterling serves better than the dollar when talking in sums that are almost astronomical in their magnitude. By taxation alone a sum of money has been raised more than double the revenue of the country before the War. They have spared nothing. The United States has already increased her national debt from 1040 to 3105 million dollars. The income of the United States is ten times its debt and its total wealth, $187,500,000,000, is such as to justify the lavish expenditure now being incurred to save our country from the gravest peril that has ever menaced it. All of this wealth would count but little in our defence if we had not the national character to use it efficiently and effectively for the great purpose in hand—to prevent the domination of the world by a military caste having no sense of honor.

MANGANESE constitutes a vital factor in the basic industry of steel-production. A keen realization of this has come to our people as a result of the exigencies of war. Many important foreign sources of supply were immediately closed, and such as were accessible to us and to our Allies soon proved nearly unavailable on account of the lack of adequate shipping to bring the ore from Brazil and Cuba. So long had we depended upon the stability of commercial relations with other countries that no serious effort had been made to secure an internal balance of our domestic resources. In this instance, as in so many others, we had neglected to prepare for the emergency of isolation. We publish in this issue a contribution on the possibilities of manganese production in California by Mr. George D. Louderback. His official position as chairman of the committee on geology and mineral resources of the California State Council of Defense, and his high standing as a geologist, give special value to his statement. He shows that the outlook for increased production is favorable, and he calls attention to the important studies being made in the concentration of low-grade manganese ores by Mr. E. A. Hersam in the University of California, and by the U. S. Bureau of Mines, as a result of which we may hope for the continuance of manganese mining after the War. The object of continuity should not be overlooked in the efforts made, under the impulse of extraordinary need, to utilize the resources that a bountiful providence has placed at our command. A wise nation is one that prepares for every contingency, and foresight directed toward economic independence is one of the essentials for protection against international difficulties. Professor Louderback also outlines a plan for encouraging the development of small manganese mines by association for purposes of assembling, grading, and shipping ores. We have urged also the organization of small producers of other ores, as a means for assisting the sale of their output. Much of the complaint against unfair treatment by the smelters is the result of faulty sampling by the shipper, to which must be added the inability of the smelting companies to quote as favorable terms to small producers as are freely offered to those that can ensure a steady supply of ore of known grade and composition. An association of small copper miners, for example, producing from a district accessible to a common shipping-point, might readily accumulate ores in such quantity as to make them, acting as a collective shipper, important enough to command respectful consideration and to secure advantageous contracts for the disposal of their products.

Every Ounce of Our Strength

Despite the fact that this Nation is committed to the decisive arbitrament of a fateful war, it is evident that many of our citizens still fail to realize how momentous is the crisis. A friend of ours, a mining engineer of wide experience, commenting upon the recent meeting of the American Institute of Mining Engineers at New York, wrote that the proceedings "brought a realization of the fact that if the country put forth *a fraction* of its potential abilities and energy the cumulative influence on the War and on subsequent civilization will be irresistible." The italics are ours. The man that wrote this could not have meant what he said, for he is one that knows better, but apparently he echoed the talk around him—talk of a damnably pernicious character. As far as one can see, if this country should put forth only "a fraction" of its strength at this critical hour on this day of "unspeakable agony of the nations," it will fail in its purpose and have to face, if not defeat and invasion, a state of things that means an end to peaceful democracy, to national safety, and to the progress of the only kind of civilization under which free men care to live. The story is told that a negro condemned to death for crime was standing under the gallows when the sheriff informed him that it was his legal right to make a statement. "Have you anything to say?" asked the sheriff. "Yes, sir; I want to say that this am suttenly goin' to be a lesson to me." Uncle Sam must not wait for such a lesson. Is this country to realize, only when it is too late, the sad consequence of half-hearted effort, or shall the whole people as a unit put forth every ounce of strength so that in the hour of judgment, inevitable when the tumult and the shouting dies, we shall stand safe and self-respecting? We want to be both safe and self-respecting if we are to continue to be a leader among the nations, if we are to keep alive the soul of representative government, if our hearths and homes are to be inviolate from the ruthless tread of a military domination that is without conscience and without shame. Most of our readers recognize these facts, but that is not enough, they must make it their business to instruct the less informed. The War cannot be won by the minority of educated people. Our profession is answering the call for personal service at the front, but there remains much to be done by those unfit for the one service that transcends all others in value and effective-

ness; we who remain at home can help by teaching those around us that this is a business to which each and every citizen stands committed. For example, the Garfield order for saving fuel was given a national interpretation, the resentment against personal discomfort showed how little most people appreciated the relation of the order to American help overseas, that is, to the success of the military campaign upon which everything is staked. We are continually diverted from intensive effort by announcements of sudden discoveries to defeat the submarine, by wild assertions concerning the squadrons of aeroplanes ready to end the War, by persistent yarns that the Enemy is in a bad way economically, and by irresponsible chatter from prominent men suggesting that the fighting is to end next month, next Christmas, or next spring. On the other hand, as a counter-irritant, equally pernicious, we hear exaggerated statements of an opposite nature: that the submarine menace is triumphant, that our munitions are terribly defective, and that the War will last twenty years. Then, as if to ridicule even the belated efforts we are now making, the 'Evening Howl' turns a patrol-skirmish into "an American victory," in big head-lines, and the 'Morning Scream' measures our accomplishment by the number of socks sent to the soldiers. Geographic separation from the scene of actual conflict and the lack of imagination characteristic of the uneducated, including many of academic standing, explains much of this profound ignorance concerning the vital issue. It is the business of every patriotic citizen to do his best to remove ignorance and to stimulate interest, so that we may go forward in unison to complete our task, which is to vindicate the law of nations and to bring the outlaw to account for his crimes, so that civilization may survive. One curious sidelight on current opinion is the interpretation of the British phrase 'to do your bit.' It is the English soldier's mock-modest way of saying that he is ready to lay down his life for his country and its cause; here in California it is taken literally as meaning that every member of the community must do a little, the cumulative effect of which is to suffice. This is another phase of the idea that if we put forth "a fraction" of our energy we, being a great and resourceful country, shall turn the tide of war. So one man subscribes a dollar to the Red Cross, another foregoes pork on Saturdays, and a third pays 50 cents for a ticket to a concert for the French wounded, and then fools himself into the belief that he has done his 'bit'! How pitifully stupid! Public dining and public dancing continue with cynical contempt for the nation's travail, golf tournaments and symphony concerts are held as if the pentecost of calamity were only a nightmare, tourists go their irresponsible way, politicians play politics, labor goes on strike, 'business as usual' is the motto of a large part of our population, as if the criminal folly of that sentiment had not been proved in England three years ago. The idea prevails that Uncle Sam is invincible, that he is sure to come out of this affair, as from others, with a victorious eagle perching on his shoulder. We hope and believe it, but in the name of Washington and Lincoln, for the sake of all that makes life worth while, let us not stop at hoping and believing. Let us act! Our own deeds are our doomsmen.

Oil-Shale Legislation

Development of oil-shale is attracting well-deserved attention, after having been side-tracked as an American industry for nearly 80 years. The early efforts to distill oil from shale did not long survive the discovery of petroleum in the wilderness of western Pennsylvania. We are talking of the period when Millard Fillmore was President; when a Scotch boy named Andrew Carnegie had just arrived in this country from Dumferline; before there were steel mills on the Monongahela and the Allegheny; when western Pennsylvania still was a region of unsubdued mountain and forest. At that time the distillation of shale available on the Atlantic Coast offered relief from the rising price of sperm-oil. Once again, after the market has been held so long by petroleum products, the growing cost of oil has turned the world's attention to the vast store of hydrocarbons that can be produced from bituminous or oil-bearing shale. The quantities at command from this source are measurable in billions of barrels; the evidence presented to the Public Lands Committee of the House of Representatives the other day showed possibilities so great than even 'billions' served as a small measure. Extensive areas in the United States contain shale from which more than a barrel of crude oil per ton may be distilled, and in addition enough ammonia may be recovered at many places to repay the cost of mining and treatment. It must be noted that the distilling of oil-shale is a technical process, requiring men of special training. It is not a safe business for the tyro. Nevertheless, it is an industry to which an army of young chemists and engineers will turn, with advantage to themselves and the world. The need for more and cheaper distillates to drive auto-trucks and aeroplanes alone is sufficient to induce the exploitation of oil-bearing shales. We publish in another column an interesting article on the oil-shale of Colorado by Mr. R. L. Chase. A rush has ensued to locate the more accessible outcrops in Colorado, Utah, Wyoming, Nevada, and California, and the question of obtaining unassailable title has become urgent. The Federal statutes make no specific provision in the premises. Presumably locations can be made under the placer law, and the Interior Department has so advised, but those interested in developing the new industry argue that the rules applying to placer claims do not fit the conditions of oil-shale mining. An association claim covers only 160 acres. This is small, and does not pre-suppose equipment for underground mining and ventilation. A plant for highly economical operation is so costly that a long life for the enterprise must be assured. A bill to cover the requirements is under consideration, and those interested in oil-shale distillation have represented to the Public Lands Committee in

Congress that a claim of 6000 acres is not excessive. To this the law-makers demur. We believe that the demand of the operators is fully justified. Although the aggregate resources of oil-bearing shale are large, it is evident that the margin of profit in exploiting them will not be great. The mining of the shale, especially where the thickness of the deposit is considerable, will present difficulties; distilling and refining plants are elaborate and expensive; from a financial point of view it will be a less attractive business than coal mining, and the equipment of a coal mine, for economical production, necessitates so large an outlay of capital that an area of 5000 acres is regarded as affording a minimum basis for a conservatively managed enterprise. It would be a misfortune to cripple a promising industry by obstructive legislation. Unwise action, in the name of conservation, resulted in the paralysis of potash development, in consequence of which we were unable to meet the demand for intensive fertilization of our farms at an hour of crisis. Similarly the phosphate deposits were tied up, so that we were unable to utilize the large possibilities of by-product sulphuric-acid manufacture in Utah and Montana that might have turned the Western phosphate-rock into fertilizer to supply the demand that today cannot adequately be met. Laws that interfere with the normal development of mineral resources restrict the growth and welfare of the Nation. The need for oil warrants the intensive development of the shale deposits to the limit of their capability; we hope therefore that Congress will take a broad and liberal view of its responsibility in this instance. Moreover, action should be taken promptly, so that initiative in this new industrial departure may not be intimidated by uncertainty regarding the treatment to be accorded by the Government.

A National Boycott

A few days ago the Chamber of Commerce of the United States of America, at the instance of the Boston Chamber of Commerce, submitted to its members a referendum, having for its burden the boycotting of German goods after the War unless the form of government in that country were radically changed. It is hard to understand why intelligent men should expend intellectual energy upon such a problem at such a time. Most people have become convinced that this war is not to be won by conducting a mere publicity campaign for democracy. An attempt to frighten the Germans into liberalizing their government by means of a threat of trade reprisal is unworthy of a body of representative Americans. It ought to be known to the leaders of industry, if not to the rank and file, that racial and national animosities do not operate persistently against the economic law that men invariably buy in the cheapest market. Sentiment will not constrain them to purchase the dearer article because it is made in a particular country. We may as well face the facts of human psychology. While our Government is struggling against the evil of profiteering, which is nothing more nor less than the exploitation of our own people at a time when the best of them have dedicated themselves to the national cause, it is foolish to assume that business after the War will not be done on a strictly business basis. It is certain that discrimination against German goods will not be applied widely unless they cost more. If the Chamber of Commerce were to propose exclusion by a protective tariff, we would admit that it had a feasible plan. That it did not propose this is probably because President Wilson, on whose shoulders rest the grave responsibilities of national policy at a time of bitter stress, had pronounced in favor of free trade. That re-opens the long-debated question of protectionism, which came near to splitting Congress along party lines a few weeks ago when the President made his open-door declaration. It is more than probable, however, that unless the Germans meet a tariff-wall too high to be climbed, it will be impossible to exclude their goods by voluntary boycott. The mere proposal argues lack of serious thinking on the great problems before us. We must defeat Germany, or she will force her goods, her language, her customs, in short, her 'kultur' upon us. Germany is fighting for world dominance, and that means mastery. Her people believe that they are the standard-bearers of civilization; Hegel told them so, and he merely gave form to the idea that had long floated in the German mind. Every Teutonic philosopher and publicist since Hegel has reiterated it. Germany is now pushing into Asia Minor; she is converting the Balkans as fast as she can into an impregnable fortress to serve as a base for an onslaught upon Greece; she has declared the way free of obstructions to Persia, and with sorrow we must admit that so it is. We reflect upon the fine little army in Mesopotamia, with its line of communication depending, among other things, on keeping the Teutons out of Greece and Italy. There in the Levant is in progress the campaign that may settle the question for you and me as to the kind of cultus we may find it needful to adopt. There are bigger and better things to do at present than consume the time of business-men in discussing boycotts after the War as a means of checking the Prussian. If a boycott be in order, let it be proclaimed against the profiteer within our gates, against those that are doing so much to aid the Enemy, by checking and harrassing our own people in the work of the War. The Chamber of Commerce knows full well that a boycott against certain meat-packers and certain wool-merchants could not be made effective. That serves to illustrate the kind of trivialities on which they have been spending time while the country is calling for constructive thinking that can be carried into action to prevent the further success of German arms. Let us consider what we can do to keep the Mediterranean safe and to hold back the Teuton from the Pacific and the Indian oceans. Then we can turn to the West Front and break it in, after which the Germany that now threatens to absorb the world through the schemes of its new Imperial Ministry of Economics will no longer exist. We must plan, not for a feeble boycott, but for an association of nations strong enough to curb any outlaw.

Herbert Hoover, as Individual and Type

By VERNON KELLOGG

*The biographical details of Herbert Hoover's earlier years will not go far in explaining to us his present personality. Born in 1874 on an Iowa farm, of Quaker father and mother, he received through them that native endowment of potentialities which come, variously, to each of us by the process of heredity; processes still mysterious despite all the wealth of detail of mechanism and method which modern post-Mendelian study of heredity has revealed. We do know something of why a man's eyes are blue, if they are blue instead of brown, as another man's eyes are; and something of why he is mentally defective from birth, if he is, while another is so mentally sound.

But despite the cheerful confidence of those too optimistic specialists who say that the secret of inheritance is now known, and that, being given full knowledge of one's ancestors and collaterals to the number of several dozen, they will prophesy the physical and mental make-up of one's next child, the fact is that they cannot. They cannot, if for no other reason than that human births are too few per family to give them the advantage of the working of the Mendelian mathematical formulae on which their phophesying is based. Besides, they can rarely have that full knowledge of ancestry which they need. Mr. Hoover does not know, nor do I, the full history of his ancestry and collaterals, and the mere knowledge of the make-up of one's parents and of a few grand and great-grand-parents, is never sufficient to explain why anyone's inherited characteristics are just what they are.

The influence of one's environment is sometimes more nearly determinable. But there is one great difficulty about that, too, and that is, that to understand fully the effect of environmental influence requires a pretty good understanding of the native qualities of the material upon which the environment acts. The reaction of differently formed human beings is never exactly the same even when the environmental action on them is nearly identical. 'You can't,' as David Starr Jordan is wont to say, to explain some failures of college endeavor, 'put a thousand-dollar education into a fifty-dollar boy.'

Herbert Hoover's early environment was affected by the death of both parents while he was a child and his being handed over to the sympathetic care of various aunts and uncles, all of the Quaker faith and training. This condition must have placed in his own hands earlier than is usual with most of us, a certain personal share in the determination of his own environment. For example, when the time for his preparation for college came, he found himself on the Pacific Coast under the care of a Quaker uncle, who had naturally planned that this preparation should lead him into a Quaker college. But already the youth had decided that his higher education should be obtained in a modern scientific university. This was a decision determined partly by the lack of control of the environment itself but more probably by the assertion of an inherited quality which made strongly for self-determination of behavior. He went, therefore, to Portland, and, supporting himself by his own exertions, was able in a couple of years to fit himself for his 'modern scientific university.' He entered Stanford University with the first opening of its doors in the fall of 1891, and thus entered on a characteristically pioneering career with Stanford's pioneer class of 1895. During his four years at the university he again supported himself by his own exertions.

Now, without doubt, these six years of earning his own way as a youth of fifteen to twenty-one years were an environmental influence which had its real effect, and one probably recognizable and of much importance today in its results. He learned early something enduring about values in human life; about things that count and things that are superficial. And he learned something of his own capacities, and to have confidence in them. One of his present outstanding characteristics is confidence, although a confidence never weakened by conceit.

His major work in the university was in the department of geology and mining, under the supervision of a sturdy, direct, natural teacher and investigator, John Casper Branner, a scholar of practical mind, intent on truth and essentials. This association was good environment for the rapidly developing young man, already inclined by native instinct and boy's experience to be intent on the same things.

Dr. Branner's advice to the students graduating from his department—to be miners for a while before being 'mining engineers'—was followed quite literally by Hoover, who went into a Sierran mining-camp and was there miner and shift-boss, and perhaps other things, before he turned again to mining engineering as helper in the office, in San Francisco, of Louis Janin, the best-known mining engineer in the West.

He was soon out of the office, however, and again in the mines of California, Oregon, Idaho, Wyoming, and Arizona, where he staid until he received an offer from an engineering firm to go to Western Australia. Here, in 1897, after only two years of mining engineering apprenticeship since graduation, he was an arrived and successful mining engineer in the position of manger of one of the most famous of Australian mines. There can be no doubt that native capacity was as largely responsible

*Abstracted from 'The Atlantic Monthly', March 1918.

for this swift achievement as good training and other environment.

In antoher year (1898) he was manager of two other great Australian mines, and in one year more he was director of mines for the Chinese Empire. This gave him a chance to go through some highly spiced adventures in Tientsin during the Boxer Rebellion of 1900.

Crossing with him from Thamesmouth to Flushing in the summer of 1915, on one of the small Dutch boats which were allowed by Germans and Allies to maintain a precarious cross-Channel connection between the Continent and England, I heard from him as we walked the narrow decks, with a constant eye out for casual floating mines or careless submarines, many stories of his experiences in Australia and China. I do not remember many of the incidents, but I remember clearly the general impression made on me by all of them together. It was, that the chief actor in them was a man of level head, clear vision, entire fearlessness, and great resourcefulness and directness of action.

Since then I have had the opportunity, given by close association, to see him think and act under circumstances of continuous serious importance. I would use the same words now to express my present actual knowledge of his qualities which I have just used to express my impression of them gained on the uneasy little Dutch boat.

After the Chinese experience he became a junior partner in a London mining firm, at that time (1902) perhaps the greatest in the world. During this partnership, which lasted until 1908, Hoover had the experience of meeting the task, largely because of his own attitude in the matter and through his own exertions, of making good to the firm's clients the defalcation by the firm's financial member of about a million dollars. In 1908 he had restored the sum, sold his interest in the firm, and was a man free and wholly competent to go it alone successfully in the world's arena of mining business. And ever since then he has gone it alone, and successfully.

It is beyond the province of this sketch to recite any of the details of his impressively successful handling of large mining affairs in Russia, Burma, Central America, Mexico, and elsewhere. He has been successful in making money for his associates and for himself out of many undertakings; but, more importantly, he has been successful in making good mines out of what in other men's hands had been bad ones. That, indeed, has been his special work in mining: not promoting mines and selling mining shares to an easy public, but making the earth yield its treasures even when it seemed most reluctant to release them. He has made his money in mining out of the ground, not out of the pockets of investors.

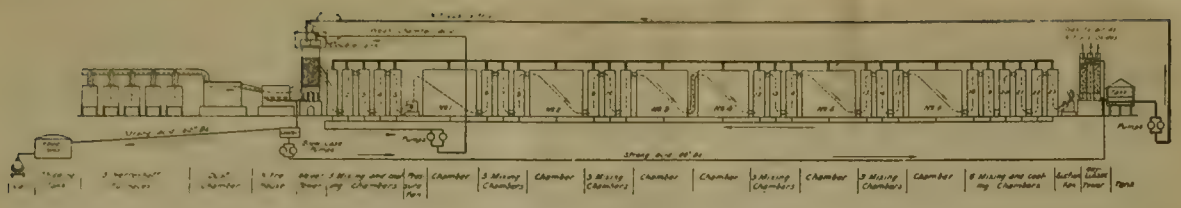
MAGNETITE ores are being smelted at Ipanema, in the State of São Paulo, Brazil, and another smelter has begun to produce pig-iron at Itabira do Campo, in Minas Gerães. On account of the availability of large quantities of water-power in the mountains along the Brazilian coast, an important development of electro-smelting in the near future is predicted by the Brazilian branch of the National City Bank.

Production of Magnesium

Four American firms produced all the magnesium in the United States in 1916 (75,400 lb. valued at $311,570), while in 1917 five firms produced 115,800 lb., valued at $233,600. Toward the end of 1917 the price was $1.85 per pound. The statistics of production were collected by Frank L. Hess, of the U. S. Geological Survey. In 1916 magnesium was made by the Electric Reduction Co., Washington, Pennsylvania; Norton Laboratories (Inc.), Lockport, New York; Rumford Metal Co., Rumford, Maine; and General Electric Co., Schenectady, New York. The Electric Reduction Co. has found it more profitable to use its power for other purposes, but the other companies produced magnesium in 1917. The American Magnesium Corporation, the successor of the Aviation Materials Co. at Niagara Falls, made an output in 1917, and the Dow Chemical Co. began production at Midland, Michigan, but was prevented from operating at its full capacity by shortage of coal. The General Electric Co., which in 1915 had been forced to make magnesium in order that it might have the metal needed for its own work, closed its plant in 1917, as the industry is now well established in this country and the price has fallen to a point near that which prevailed before the War. The Rumford Metal Co. and the American Magnesium Corporation have investigated and produced alloys of magnesium with aluminum, calcium, copper, iron, nickel, and silicon.

DIATOMACEOUS EARTH is used chiefly for cleaning and polishing, either in the form of powder or mixed with soap. It is an effective non-conductor of heat and has been used alone or with other materials as a covering for boilers, steam pipes, and safes, and in fireproof cements. It is used largely by paint manufacturers as a wood filler. Boiled with shellac it is made into records for talking machines. It has been used for absorbing liquid manures so that they could be utilized as fertilizers, and as a source of silica in making water-glass, as well as in the manufacture of cement, tile-glazing, artificial stone, ultramarine, and other pigments of aniline and alizarine colors, paper-filling, sealing wax, fireworks, hard-rubber objects, matches, and papier-mache, and for solidifying bromine. Bulletin 483 of the U. S. Geological Survey, dealing with all the economic minerals near Richmond, Virginia, gives valuable details regarding diatomaceous earth.

GYPSUM is added as flux to galena concentrate in the Carmichael-Bradford blast-roasting process of reducing lead ore, a process patented in the United States in 1902, but used only at a smelter in New South Wales. Gypsum is used as flux in the concentration of lead-copper matte in reverberatory furnaces in Germany. In the smelting of some grades of nickel ore in New Caledonia, gypsum is employed to furnish the sulphur needed for collecting the metal in a matte. The lime of the gypsum then acts as a base to slag the silicious gangue.

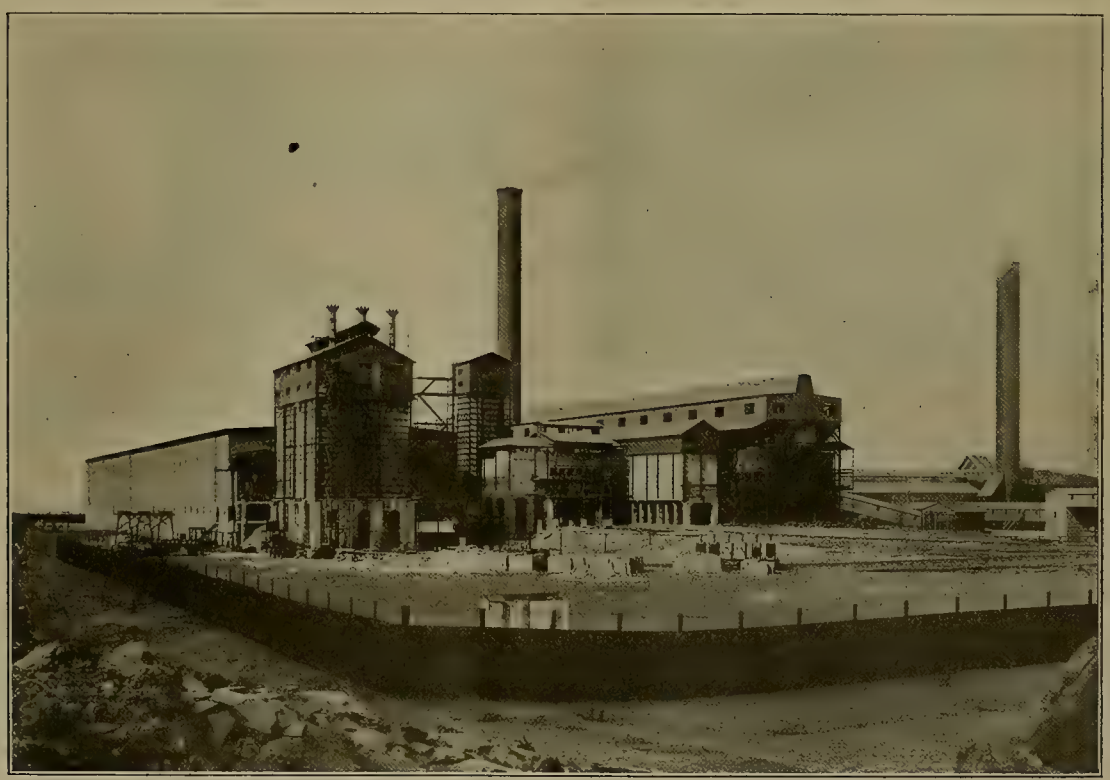


STRAIGHT-LINE FLOW-DIAGRAM OF CALUMET & ARIZONA SULPHURIC-ACID PLANT

Calumet & Arizona Sulphuric-Acid Plant

By COURTENAY DE KALB

Until recently no outlet has existed in the West for sulphuric acid. Consequently the smelters were at ceaseless war with the farmers who protested against the fume. Without disparagement of the courts it may be said that the law was generally construed in favor of agriculture, which meant that the decisions to a considerable extent followed the principle of the greatest good to the greatest number. Viewed from another standpoint, it was not possible to overlook the fact that the outcome of litigation generally bore a definite relation to political majorities as registered on election day. For exemption from these evils the smelters sought isolated sites in barren areas, but were pursued by the so-called smoke-farmers, seeking the double profit from markets created by the communities surrounding the smelters and from alleged damages to crops that they sought to collect through the courts. It is now becoming plain that these episodes were merely incidental to pioneer conditions. In the Eastern States smelters exist in crowded communities, surrounded by prosperous farms, without a clash of interests. New Jersey is full of smelters of many kinds; New York bay is encircled by them; one is in operation near the centre of the city of Yonkers on the Hudson river. The explanation is



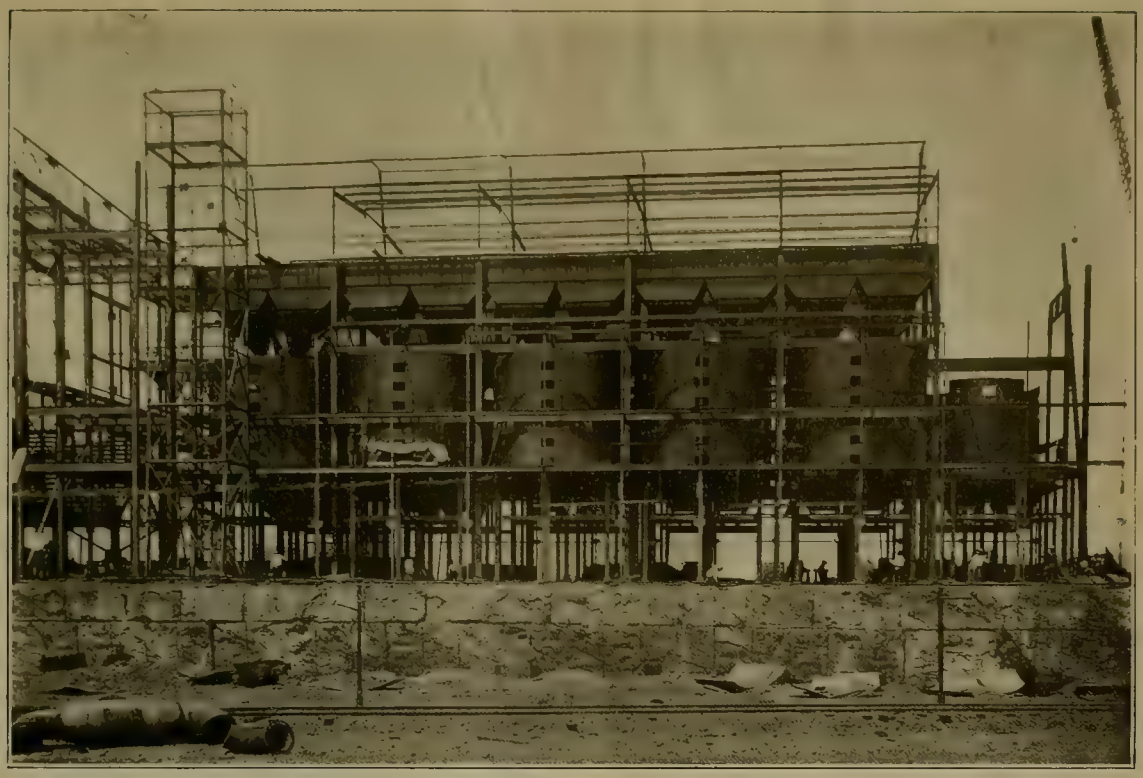
GENERAL VIEW OF CALUMET & ARIZONA SULPHURIC-ACID PLANT

found chiefly, though not entirely, in the fact that the great population of the East leads to a demand for the by-product that can be made from the fume. A like condition is developing in the West. Diversification of industry is encouraging a more insistent call for sulphuric acid, and the high cost of transporting it makes local manufacture imperative. The response is relatively easy, since the tendency to reverberatory smelting has been accentuated by continued improvements in this process, and by the increasing output of flotation concentrate, which cannot be smelted in the blast-furnace. The roasting of ore and concentrate, which is a necessary preliminary to reverberatory smelting, yields fume rich in sulphur di-oxide, and this is available for the making of acid. Moreover, one Western acid-plant, at least, has been erected partly for the purpose of supplying acid to the farmers, since it has been found that alkali lands can be reclaimed for profitable cultivation more effectively and cheaply by the direct application of this substance than by any other means. The American Smelting & Refining Co. anticipates a large demand for this use, which it is preparing to meet from its acid-annex at the Garfield smelter in Utah. At the same time the application of sulphuric acid for leaching low-grade copper ores is growing rapidly, so that smelter-fume is coming to represent an asset instead of being a nuisance and a cause of legal strife. The new development of acid-manufacture is in response to a demand from both farmer and miner. The first acid-plant in the West, in conjunction with copper smelting, was erected as an escape from the persecution of the farmer. This was at the Mountain Copper works on San Francisco bay, this plant being designed by Lewis T. Wright, who thus became the pioneer acid-making copper metallurgist in the western United States.

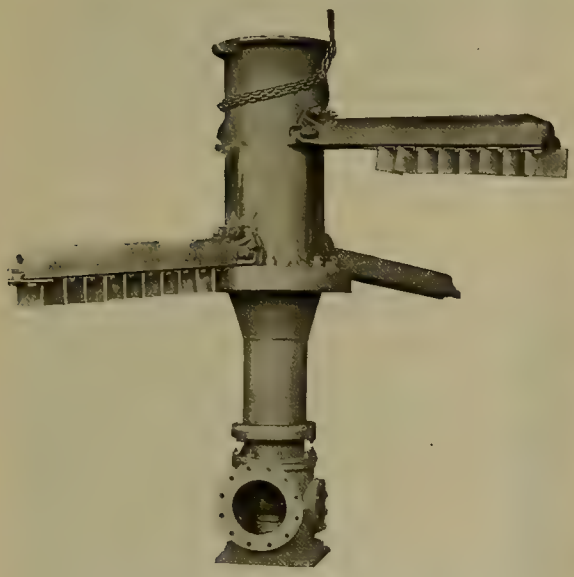
It will be recalled that when the Copper Queen officials selected the site for a smelter at Douglas, in the Sulphur Springs valley, Arizona, the absence of favorable conditions for agriculture was noted with considerable satisfaction. The elevation, combined with the extreme dryness of the atmosphere, resulted in such a wide variation in the temperature between day and night as to limit the possibilities of successful farming; but the pall of smoke that spread over the valley from the smelters reduced the radiation of heat at night so that these conditions were changed, and ranchers began to crowd around the new market established by this metallurgical industry in what before had been an almost unpeopled desert. Next followed threats of litigation because of damage to crops from the sulphurous smoke. The smelters, however, pointed out that all they needed to do was to close the works for a period to re-establish the former climatic conditions; the farmers then literally would be frozen out. Accordingly wisdom and peace prevailed together. Nevertheless, Douglas now has an acid-plant, called into being by the needs of the leaching-works at Ajo. When it became apparent that a great body of copper-carbonate ore existed at Ajo, and that it must be treated with sulphuric acid, two possible solutions of the problem had to be considered. One was to ship pyritic ore from the Bisbee mines and manufacture acid at the point where it was to be used; the other was to roast the ore at the Douglas smelter of the Calumet & Arizona Mining Co. and produce the acid there for shipment to Ajo. Estimates showed that it was cheaper to produce the acid at Douglas. It was a question of balancing the cost of transporting the acid 295 miles over three railroads, or of taking copper-bearing pyrite to Ajo, and returning the calcine for smelting. Leaching of the calcine would have involved a separate process, different from that which had proved adaptable to the New Cornelia ore, and the ferruginous calcine-tailing would have been useless. At Douglas the iron in the calcine admits of smelting an additional quantity of silicious ore. Accordingly an acid-plant became an adjunct of the C. & A. smelter, and was the first one to be built in the State of Arizona. The output is 210 tons of 60° B. acid daily, 75% of this being consumed in copper-leaching at Ajo.

Sulphuric acid in the chemical industry is a fundamental necessary. In outline the method has settled down nearly to a matter of routine, yet no branch of manufacture remains stationary. When it ceases to progress it is obsolescent. Acid-making actually is changing materially in America; in many matters of detail the world's great authoritative work on the subject, by Georg Lunge, is now out of date. The dingy, dirty, corroded wooden structures, with their encrusted and leaky lead-chambers suspended in lead pans, which one may see scattered plentifully throughout the East, and which hark back to the days, not so long ago, when the acid-makers of England and America questioned the fairness of granting a gold medal to John Glover for his famous tower, look like models of medieval crudeness beside such splendid examples of efficient engineering as may be seen, for instance, at the plant of the Davison Chemical Co. of Baltimore, where everything is built of steel and tile, with magnificent chambers burned and raised wall by wall without the distortion of lead sheets seen in the older works; where durability, neatness, accessibility of parts, perfection of detail, all unite in producing economy. It is to pay a deserved compliment that the plant of the C. & A. is compared with so noteworthy an example of modern methods; indeed, there are some details at Douglas that might serve as useful models to the able managers of the Davison Chemical Company.

Despite the fact that every chemist learns the principles of making sulphuric acid in his primary lecture-course, the complication of Western metallurgic establishments by sulphuric-acid annexes is sufficiently novel to make a brief outline of the process of use to some who may thereby be encouraged to utilize their own by-products. The object is to change the fixed gas, SO_2, into the hydrated trioxide, $SO_3 \cdot H_2O$, that is, the H_2SO_4 of commerce. In other words, it means the further oxidation of SO_2, which, in the chamber process, is accomplished in connection with nitrous oxides and water-



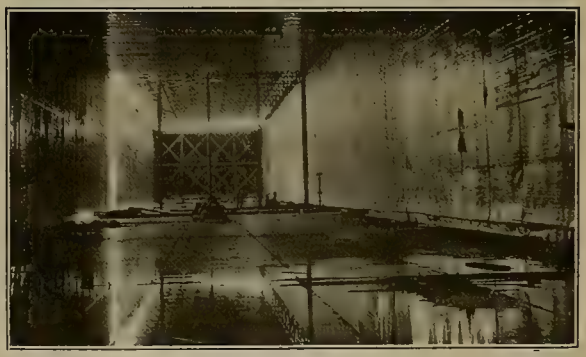
BATTERY OF HEGELER ROASTING-FURNACES, C. & A. ACID-PLANT, DURING CONSTRUCTION



PART OF COLUMN, WITH RABBLE-ARMS, HEGELER ROASTER



NITRE-POTS IN NITRE-HOUSE



INTERIOR OF LEAD-CHAMBER

vapor. • These are the fundamentals of the process. There is, furthermore, an important addition to the total yield through the action of nitrous vitriol in the Glover tower, making a stronger acid, partly by concentration of the chamber acid fed through the tower, by reason of the heat of the incoming roaster gas, and partly through the reaction, as given by Lunge:

$$2SO_2(OH)(ONO) + SO_2 + 2H_2O = 3H_2SO_4 + 2NO$$

The accompanying straight-line flow-sheet, representing the plant erected at Douglas, will enable the method to be followed more easily. The pyritic ore is roasted in the same type of hearth-calciner as that used for desulphurizing copper-sulphide concentrate preliminary to reverberatory smelting. In this plant the Herreshoff furnace is used, built by the Pacific Foundry Co. of San Francisco. The gas, containing 6 to 7% SO_2 by volume, is passed through a dust-chamber for initial cleaning. It may be stated that acid-makers aim at as high a volume-percentage of SO_2 as possible, since it enables the work to be done with smaller and fewer chambers, and, if conditions permit, a content of 7.5% average would be preferred. At Douglas, however, the roasting is done with consideration for the highest combined efficiency of both the acid and the smelting plants, limited by the available economic ore-mixtures. The nitrous oxide is introduced by the nitre-pot system, in accordance with prevalent American and English practice, instead of by nitric acid, as is more commonly done in Europe. Accordingly the hot gases leaving the dust-chamber are led by a flue to a double-compartment chamber having 12 'nitre-pots,' shaped somewhat like a bath-tub and made of cast-iron. These are charged with Chilean nitrate of soda, sulphuric acid is added, and, under the action of the heated gases, which pass over and beneath the pots, the nitric-acid vapor is evolved and mixes with the sulphurous gas. The contents of the pots become liquid, and when the reaction is complete this liquid is discharged outside the chamber, where it solidifies into what is known as nitre-cake, this is, acid sodium sulphate, $NaHSO_4$. No attempt is made at the Douglas plant at this time to convert it into salt-cake, Na_2SO_4, nor is it used, as at places where the demand justifies such a step, for making hydrochloric acid by heating it with common salt, or roasting with coal in a reverberatory type of furnace to form sodium sulphide. It here constitutes a waste product, and it accumulates at the rate of 2 tons per diem. The gas enters the nitrating-chamber at a temperature of 800° to 900° F., and thence passes to the Glover tower, which is filled with a checker-work of Duro chemical tile, where it meets descending films of sulphuric acid mixed with nitrous vitriol. The ensuing reaction utilizes the nitrous oxides in these liquors by combining with some of the SO_2 in the gas. At the same time the stream of gas is cooled to about 210° F., and the resultant evaporation helps to concentrate the acid which, at the Douglas plant, is drawn from the towers at a strength of 60° B. This is the finished acid as shipped to Ajo. Only a part of it, however, is diverted to the storage-tanks; the greater portion is necessarily returned to the Gay Lussac towers, where it recovers the nitrous oxides that issue with the waste-gas from the last lead chamber in the series. It then circulates, as nitrous vitriol, once more through the Glover tower, thus maintaining a cycle. The gas emerging from the top of the tower goes through a series of five tall cylindrical cooling-chambers, made of lead, and permitting radiation of heat through the walls. These bring the temperature down to 190° F. A large lead fan exhausts the gas from the cooling-towers and forces it into the first lead chamber, where the reaction that results in forming sulphuric acid takes place. There are six lead chambers, with three cooling-towers between each pair, with the exception of chambers No. 3 and 4. In many plants steam is introduced into the chambers, but the reactions being exothermic, and a reduction of the temperature being necessary to facilitate good work, 'atomized' water is preferable and is here used in accordance with the best American practice. The water is atomized by the Schutte & Koerting Co.'s type of platinum-pointed spray-tip, just inside the roofs of the chambers. The chamber-acid produced is approximately 53° Baumé. This is maintained at a constant level within the chambers, the excess siphoning off and joining the cycle through the Gay Lussac and Glover towers. From the last of the six chambers the gases issue at a temperature of 140° F.; thence they are drawn through a series of six cooling-towers by a lead fan that also drives them through the Gay Lussac towers, which are similar to the Glover, except as regards their size and details of construction. The waste-gases now containing the nitrous oxides and about 0.10% of SO_2, meet the sulphuric acid trickling down over the Duro tile, and the nitrous oxides are absorbed, forming the nitrous vitriol ready to re-enter the Glover tower.

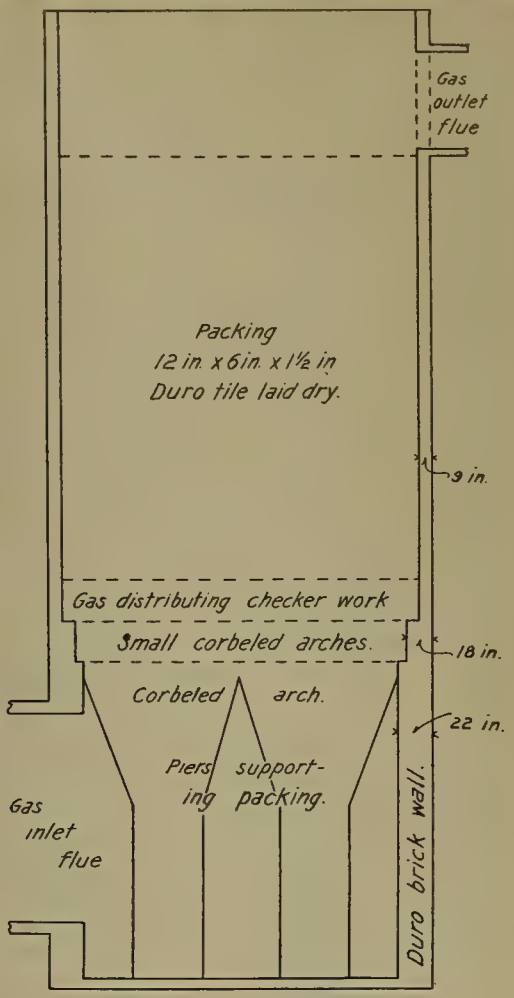
From the general view of the plant, it will be seen that the Gay Lussac and the Glover towers, the 'nitre-house,' the cooling-tanks, the dust-chamber, and the roasting-furnaces, are concentrated at one end, that is to say, the gases, after traveling ahead through three lead chambers, double back through another parallel series of three more chambers to the Gay Lussac towers. This facilitates technical control as well as convenience in operation, and is a plan common to all modern plants. The Calumet & Arizona plant was designed by the Process Engineering Co. of Philadelphia, the actual construction being done by the engineering and mechanical departments of the Calumet & Arizona, aided by C. S. Rogers, construction engineer of the Process Engineering Co., in conjunction with A. C. McGregor, mechanical engineer of the Calumet & Arizona company. At present K. B. Thomas is the superintendent of the plant.

Roasting is done in a battery of 24 Herreshoff furnaces, each having six hearths, 21½ ft. inside diameter, lined with 9-in. firebrick, contained in a shell of ⅜-in. steel-riveted sheets. The hot air from the cooling-column passes downward through a series of rectangular bustle-pipes, 6 by 12 in., spaced 2-ft. centres, built into the brick wall. This serves to economize the heat that would otherwise be lost, and to maintain a proper working-temperature on the hearths. The speed of the plow-arms is one revolution per minute, and each furnace requires 7½ hp. Of the entire battery of furnaces, 19 are used for roasting an excess of ore beyond what is needed to

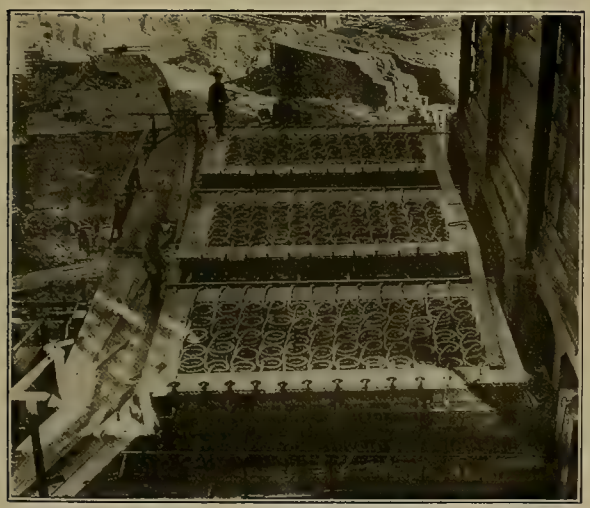
supply SO_2 for acid-manufacture, and the sulphurous gas from these is discharged into the air through a stack. They are referred to as 'open' furnaces. The remaining five are 'closed' furnaces, that is, the gases go to the acid-plant. There is a great difference in the speed of desulphurization in the two groups, the open furnaces treating each from 90 to 125 tons of ore daily, while a closed furnace burns only about 70 tons. The average



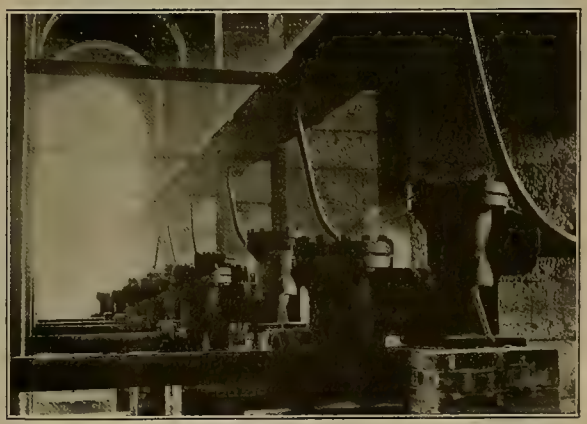
COOLING-TOWERS OF ACID-PLANT



OUTLINE SKETCH OF GLOVER TOWER



ACID-COOLER



CHECK-VALVES FOR BLOW-CASES

sulphur content of the feed is 30%, and the calcine contains about 10%. A typical analysis of the ore is as follows:

	%
Silica	20.1
Alumina	3.2
Iron	29.2
Lime	1.7
Sulphur	29.2
Copper	5.12

The copper content is raised in the calcine to 6.6% as a result of roasting. The temperature is at a maximum on the third hearth, where it is 1400° F. If the higher heat invades the second hearth the elimination of sulphur is poor. On the sixth hearth the temperature is 800° to 1000° F. The air used for cooling the arms and the central 5-ft. column enters the down-take bustle-pipes at a temperature of 450° Fahrenheit.

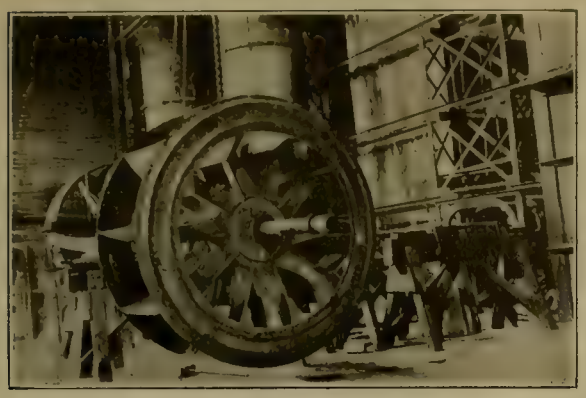
For the roasting-furnaces supplying the acid-plant there is a separate concrete dust-chamber, 23 ft. 6 in. by 20 ft. in horizontal section, and 28 ft. high, insulated with 'sil-o-cel' brick, filled with a checker-work of hollow tile, 4 by 4 by 8 in., made of hard-burned fireclay. These are set so as to discharge the dust downward. The amount of dust drawn daily is between two and three tons, the gas carrying about 1.5% of the ore fed. Once each month the chambers are blown out with compressed air. The nitre-pots are shown in the accompanying illustration. The size of each pot is 4 by 2 ft., and the chamber is 33 by 12 ft. by 19 ft. 7 in., built of concrete and lined with Duro acid-proof brick laid in Duro cement. A charge of sodium nitrate is shoveled in through the work-doors, and sulphuric acid is introduced. The amount of nitrate of soda charged varies with the entrance-gas and the condition of the chambers at the time, while the amount of sulphuric acid charged varies with the nitre charge. The reaction is complete in two hours and the liquid acid sodium sulphate is tapped out into cast-iron cooling-pans. The nitre consumed is calculated on the basis of the sulphur in the acid made, not on the amount of sulphur burned. This corresponds to 2½ to 3% of the sulphur content of the acid. The nitre contains 96% $NaNO_3$, and costs about 3½c. per pound.

The gas, now at a temperature approximately 20° lower than the gas entering the nitre-house, is delivered to the Glover tower through a lead flue 11 by 15 ft. This tower is octagonal, 22 ft. 2 in. diam. by 56 ft. high. It has a steel frame, holding the walls, which are built of Duro brick laid in Duro cement, containing about 96% silica mixed with sodium silicate as a binder. The tower is packed with Duro tile, 1½ by 6 by 12 in., laid in checker formation as shown in the illustration, which is a view taken above the packing. The tiles are so laid as to be self-supporting; thus they exert no thrust upon the walls such as must be resisted when quartz packing is employed. This acid-resistant 'chemical tile' is made by the Harbison-Walker Refractories Company.

After the gas has lost some heat and has parted with a portion of its SO_2 in the Glover tower, it is conducted through a 6 by 10-ft. lead flue to the first series of cooling-towers, each of which is made of lead sustained by a steel frame, and is 41 ft. high by 17½ ft. diam. The gas enters at the bottom and leaves near the top, both inflow and outflow pipes being connected tangentially so as to induce a spiral motion. The gases are thus driven toward the periphery, facilitating the radiation of heat through the lead wall. The motive-power for drawing the gases from the Glover tower and through the cooling-towers is supplied by a lead fan, 4 ft. wide and 8 ft. diam., with a speed adjustable within the limits of 150 to 200 r.p.m., and moving a volume of 60,000 to 70,000 cu. ft. of gas per minute. The use of the cooling-towers increases the reaction, thus economizing the nitrous oxide, and yet holding the temperature lower. The fan delivers the gases into the first acid-chamber, which is 143½ ft. long, 59 ft. wide, and 41 ft. high. There are six similar chambers, with cooling-towers between, as previously explained. The accompanying view of the interior of a chamber, taken during construction, shows the bottom sheets of lead, which weigh 8 lb. per square foot, and also the edges that have been burned together. Likewise the seams of the vertical sheets stand out clearly. The side-walls consist of 6-lb. sheets of lead. Six sheets, making five seams, are burned with the sheets lying flat. This makes a better seam. The section is then raised into position, and the laps between successive sections are burned together. The top is also of 6-lb. lead, burned flat on temporary staging. There is no acid-pan, but the bottom 8-lb. sheets are turned up and burned solid with the side-wall sheets. The chamber rests on a slatted floor to admit of better radiation, and the top is hung from the steel framework, as seen in an accompanying illustration. A detail drawing shows the method of attachment. Lead straps are burned upon the 6-lb. top sheets, and turned to form an eye to receive a ½-in. iron bar on the end of a threaded hanger with a special nut or washer resting on a pair of adjacent angle-bars.

The total space in the six chambers and the 23 cooling-towers combined is 2,155,000 cu. ft., affording a little more than 12 sq. ft. of radiation surface to every 100 cu. ft. of capacity. For the addition of the water necessary for effecting the acid-forming reactions the Schutte & Koerting platinum-tipped jets are used. These disperse the water in the form of a fine mist. The first chamber is provided with 12 jets, spraying 2½ gal. each per hour. The second chamber has 24 jets, the third chamber 28, and the fourth 24, each spraying 5 gal. of water per hour; the fifth chamber has 20 and the sixth 12 jets, each delivering 2½ gal. of water per hour. The intermediate cooling-towers also have one jet each, spraying 2½ gal. per hour.

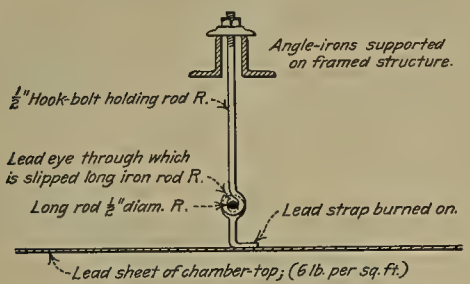
A second lead fan, of the same dimensions, namely, 4 by 8 ft., placed at the end of the system of chambers and cooling-towers, forces the gas into the Gay Lussac towers. These present a radical departure from the usual construction. Twelve towers are built into a solid



IMPELLER OF LEAD GAS-PUMP



DURO-TILE PACKING OF GAY LUSSAC TOWER

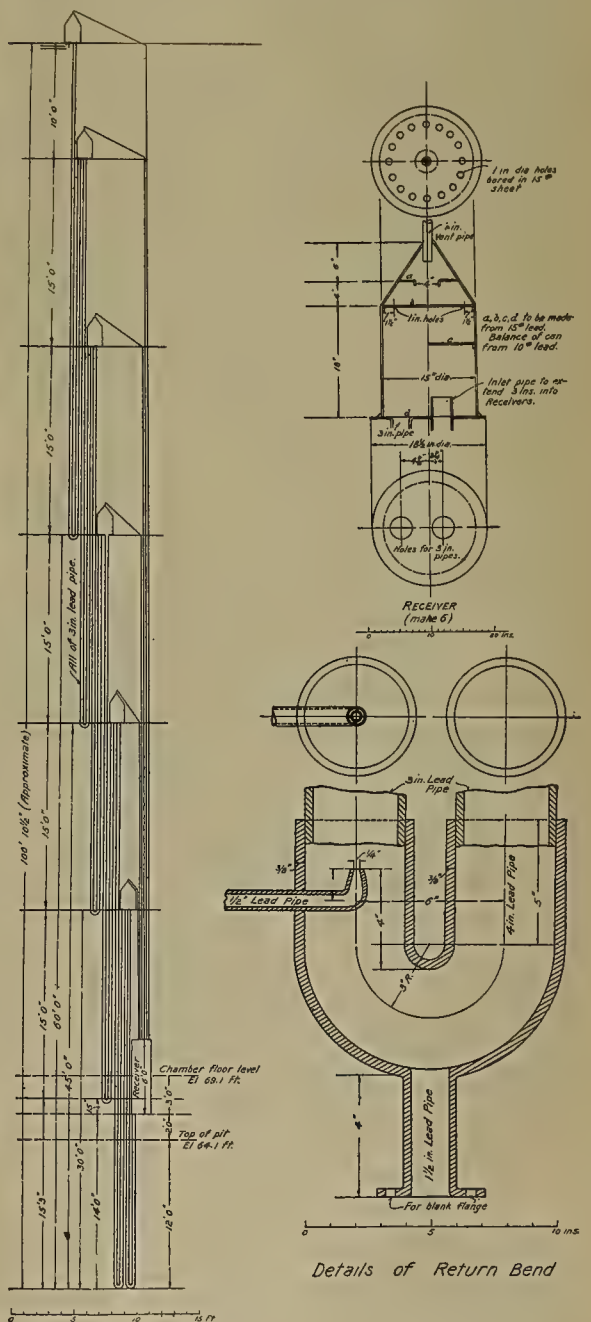


METHOD OF HANGING TOP OF LEAD CHAMBER



METHOD OF SUPPORTING CHAMBER-TOP

block, each tower being 13 ft. square by 45 ft. high. They are built of Duro brick, laid in Duro cement, and the interior is packed with Duro tile in the same manner as the Glover tower. It has been the general custom to pack Gay Lussac towers with hard-burned coke. The pores of the coke fill with acid, so that only the exterior of the pieces remain effective in presenting the films of acid to the gases, but it has been thought that the roughness of the surface extended the film of liquid and produced superior results. The Duro tile, however, as em-



MULTIPLE-STAGE PEBBLE AIR-LIFT FOR PUMPING ACID

ployed in the plant of the Calumet & Arizona, has yielded as good an effect, and the packing is indestructible. The cold acid pumped from the Glover tower issues from the bottom of the fourth Gay Lussac with a nitrosity equal to 1½ oz. $NaNO_3$ per cubic foot of acid; from the second with an equivalent of 10 oz.; and from the first with a nitrosity of 35 to 40 oz. The entire block of Gay Lussac towers is enclosed in lead sheeting, hung upon a steel frame. The towers are so arranged that the gas coming from the chambers is divided into three parts, each part passing independently through a series of four towers. At the base of each of the last three the discharged acid is cooled in acid-coolers before being pumped to the next tower in the series. Large steel blow-cases are used for the circulation of the tower-acid, each blow-case having a capacity of 20 tons of 60° B. acid. This pumping system is in duplicate to avoid delay when repairs are needed.

The acid from the chambers is elevated 90 ft. to the Glover tower by an ingenious adaptation of the Pohle air-lift. This is shown in detail in the accompanying illustration. The acid is lifted in stages, through lead pipes, the distance between successive receivers being 15 ft., while the total lift in each column is 45 ft. The compressed air is introduced by a jet, as shown in the detail drawing, just above the bend of the pipe. The acid flows by gravity from the receiver, and the air lifts it to the next receiver above, and so on to the top. The adjustment of the air-pressure is accomplished by a Davis regulating valve. This simple device has a pumping capacity of 300 to 500 tons of acid per diem.

The cooling-tanks are built with steel frames, inside of which is a 6-lb. lead sheeting, lined with 4 in. of Duro brick laid in Duro cement. They are 16 by 9 by 5 ft., and each tank contains 5000 ft. of lead pipe, 1½ in. diam., with ½-in. walls. Instead of being in large coils, the lead pipe is in coils 15 inches in diameter like coil-springs. They are then placed in the tanks with the central axis in a vertical position. Each coil is independent of its neighbors and is easily replaceable. The total length of coil for a given capacity of tank is increased 40% over the old system by this arrangement.

It is a matter of peculiar interest to find Arizona among the sulphuric-acid producing States of the Union. The cause for such an enterprise here has been the requirement for leaching copper ore, and the plant was built primarily to meet this necessity. Nevertheless, it has already responded to a wider demand, so that a fourth of the output is shipped to other points than Ajo. The success attending the leaching operations in the plant of the New Cornelia Copper Co. will promote the application of the process to ores in other localities, and this will extend the market for acid. Furthermore, the general consumption in the arts is certain to increase throughout the West as a result of the intense stimulus given to manufacturing by the extraordinary conditions that the War has created. A country once awakened to its opportunity for producing the articles of common need will not lapse into inaction after the initial impulse has been withdrawn; the freight differential alone will serve to maintain a protective margin of profit sufficient to ensure the continued growth of industry once established. Since sulphuric acid is recognized as a criterion of industrial development, it is evident that a large demand for this chemical henceforth will encourage the utilization of the waste smelter-fume in the Western States. The Western farmer is beginning also to appreciate the need of super-phosphate, to which he has been relatively indifferent in the past. This will call for the mining of phosphate rock from the great deposits that stretch from Wyoming and Utah into Montana and Idaho. It is by no means improbable that the smelters in Utah and Montana soon may find it profitable to ship fertilizers to the agricultural districts of the Mississippi valley, by reason of their command of a cheap source of acid-making material in close relation to large deposits of raw phosphate. It is certain that the manufacture of sulphuric acid will soon become a notable feature at many of the copper smelters throughout the West.

BRAZIL has made its first steel. This was accomplished in the Engenho de Dentro works of the Central Railroad of Brazil, about 10 miles from Rio de Janeiro, on October 19, 1917. Up to this time all attempts to manufacture steel from native pig-iron apparently had not been commercially successful. The railroad used a Whiting converter, purchased in the United States, and though the steel was for its own use in locomotive-parts, the success of the undertaking is looked upon as demonstrating the commercial possibilities of the process. The Central Railroad foundry constitutes part of its locomotive repair shops. As a portion of its equipment two No. 3½ cupolas, purchased from the Whiting Foundry Equipment Co., were erected in 1914, having a rated capacity of five to six tons per hour. For some years it has been making gray-iron castings ranging in size to 3000 lb. Native pig-iron, with a mixture of about 40% scrap-iron, but without steel-scrap, was used.

A RECENT method proposed for fixing nitrogen from the air, as described by L. L. Summers, consists in mixing manganese di-oxide with powdered coal or coke, this being placed in an annular reaction-zone of an electric furnace. When the charge has become bright red, preheated air is introduced through tuyeres, the temperature of the mass being maintained at about 1000° or more. Carbides of manganese are formed, which fuse and then decompose at the higher temperatures, and volatilized compounds of manganese, nitrogen, and carbon are formed, which issue from the closed furnace to a condenser where the nitrides are decomposed to obtain ammonia. Cyanogen compounds and oxides of nitrogen are also produced. Coal may be substituted for coke, and producer-gas for air, in which case derivatives of cyanogen are obtained. It is suggested that the same apparatus may be used in the manufacture of manganese carbide suitable for producing CH_4 for gas-enrichment.

The Oil-Shale of Colorado

By R. L. CHASE

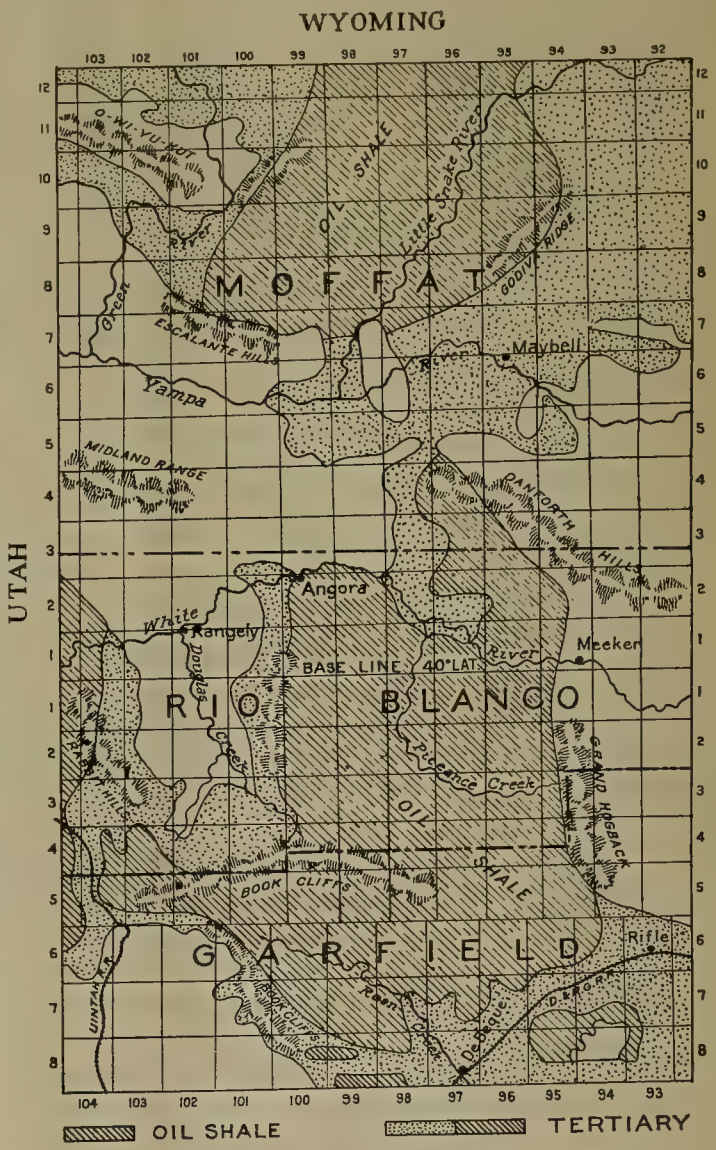
A new industry for the United States is starting in north-western Colorado and bids fair to assume tremendous proportions in the near future. This industry is oil mining, and consists of the mining of oil-shales, and their destructive distillation with the production of oil and other by-products.

On the accompanying map I have shown the area of oil-shale in Moffat, Rio Blanco, and Garfield counties, covering 2500 square miles. The oil-shale occurs in the upper part of the Tertiary rocks, in what is known as the Green River formation. This formation reaches a maximum thickness of 2500 ft. and consists essentially of shales with narrow beds of sandstone interbedded. The upper and lower parts of this formation are relatively barren, the middle portion forming the commercial beds of oil-shale.

The shales lie practically horizontal; at one time they formed a plateau about 9000 ft. above sea-level. Since then erosion has been active, and the plateau has been cut by streams leaving mesas that tower in some instances 1000 ft. above the valleys. It is the mesas and hills that contain the oil-shale, usually as a cap, because the oil in the shale cements it and makes it resistant to weathering. A rich stratum of shale is thus easily distinguished from the poorer, as it forms projecting combs along the outcrop. The rich and poor strata are interbedded, so that a rich stratum may alternate with a poor one. The workable beds are those that can show a rich section of at least three feet.

The shale is light in color at the outcrop, the poorer varieties being nearly white, whereas the portion that yields the most oil has a grayish tint. This gray shale, however, shows a dark-brown to black color on a freshly broken surface and appears massive. Upon being burned it breaks down and shows the shale-structure clearly. This weathering extends only a few inches to possibly a foot from the outcrop, so it is easy to get to a fresh surface for sampling. The oil occurs in the shale as a mass of plant and animal remains plainly discernible with the microscope. When the shale is heated the oil is driven from these organic remains, as all organic matter carries some oil. If these beds of shale had been covered by later formations and been subjected to heat and pressure the oil would have collected and we would have had an oilfield.

The oil content of the richer portion of these shales varies from 10 to 90 gal. per ton, making a bed of commercial thickness that will produce 40 gal. per ton not uncommon. The most valuable by-product is ammonium sulphate, many beds of shale yielding 17 lb. per ton.



OIL-SHALE AREA IN COLORADO

It is said that shale carrying 1% nitrogen will yield 65 lb. of ammonium sulphate per ton.

The distillation of oil-shale is by no means a new thing, for it has been carried on successfully for many years in Scotland, France, and other countries on shales not as rich as these of Colorado. In Scotland the shale beds have a dip of about 35°, making mining difficult, while the average yield per ton of shale has been estimated at 25 gal. The cost of mining has been $1 per ton, 40c. per ton for distillation and 46c. per ton being the cost of producing ammonium sulphate from a ton of shale.

In Colorado many shales produce 40 gal., or one barrel per ton, as there are 42 gal. to the barrel. The cost of mining on a large scale would be low, as the strata lie horizontally, and in some places it would be possible to strip the deposit and mine with steam-shovels. Probably a 75c. to $1 mining cost would be realized. The cost of distillation and the cost of producing ammonium sulphate would be higher than in Scotland, owing to the higher cost of labor and material. This might be offset by improvements in the plant. Ammonium sulphate is worth at the present time 7c. per pound and is therefore a valuable by-product. The industry in Scotland has paid handsome profits while working much lower-grade shale situated less favorably. The value of the product has been less also, as the price paid for ammonium sulphate was formerly 3c. per pound and other things low in proportion. To offset these advantages in Colorado are the high cost of materials, high wages, and the competition of large oilfields.

If handled on a large scale the distillation of the better portions of these oil-shales should prove profitable. Several companies are now waiting for spring to build their plants and prove how profitable it may be. In some ways the enterprise is comparable to the development of the 'porphyry' coppers, where everything depended on a large production at a low cost. That is the essential feature in this case and makes necessary a large investment in plant.

Over a year ago a leading automobile engineer said, at the annual meeting of the American Chemical Society, that he preferred electric to crucible steel in the special alloys that they used. A prominent English authority recently declared: "There is no carbon steel or alloy steel and no kind of casting, whether heavy or small, that cannot be made better and more profitably in an electric furnace than by older methods." The best quality of steel was formerly made in crucibles and called crucible steel. Electric furnaces are much larger than crucibles, those of 25 tons or more being now in general use. The heat of the electric arc melts and boils the iron and refines it into steel. It is really the wholesale way of making high-grade steel against the retail way in the old crucible process. The number of electric furnaces, operating or contracted for in the United States on January 1, 1918, was 233, as compared with 136 a year ago, and with only 73 on January 1, 1916. Three years ago, on January 1, 1915, there were only 41 such furnaces. In the world on January 1, 1918, there are estimated to have been 733 electric furnaces in the steel industry, as compared with 471 on January 1, 1917, also a large expansion. With Canada credited with 36 furnaces, the total outside of the United States and Canada, on January 1, was 464 against 316 a year ago. England ranks second, with 131 furnaces, and Sheffield has 70 furnaces within its boundary, or more than any other city in the world. The world's output of electric steel is probably not far from 4,000,000 tons per year, of which the United States and Canada turn out about 45%, or 1,800,000 tons. On July 1, 1913, the electric steel industry of the United States was insignificant and Germany led the world, with 19 furnaces in the United States and 34 in Germany. At the beginning of 1918, 4½ years later, the industry in the United States had expanded over 12 fold.

Gold on Creeks in Copper River Basin

Alaska continues to be a good paying investment for Uncle Sam, its mineral output in 1917 having been more than $41,000,000, and although the production of gold was somewhat reduced the interest in the gold placers is still keen. Among the rich placer deposits are those of Valdez creek, which have yielded gold valued at $375,000.

Gold has been found in its bedrock source in the slate area south of Valdez creek and is present in some of the stream-gravel deposits within that area. Most of the placer gold from this district, however, has come from an old gravel-filled channel, formerly occupied by Valdez creek, and from the stream gravels of that part of the present channel which lies below the point where the old and new channels intersect. The gold in the new channel is largely a re-concentration from the auriferous filling of the old canyon.

Slate creek, 75 miles east of Valdez creek, is the site of an older camp. Miller gulch has been the greatest producer of placer gold within the Copper River basin, having yielded more than one and three-quarter million dollars. The U. S. Geological Survey has on hand a few copies of Bulletin 498, 'Headwater Regions of Gulkana and Susitna Rivers, Alaska,' by Fred H. Moffit, a report which deals primarily with the district including the Valdez creek gold-placers, and also gives an account of mining developments in the Slate Creek district, at the head of Chistochina river. Since the publication of the bulletin, copper deposits have been found in the Valdez Creek country within the area of basic lavas shown on the geologic map given in that report. Platinum has also been found in the Slate Creek gravels.

Ammonia amounting to 130,000 tons of NH_3 per annum is the capacity of by-product coke-oven plants at work or being erected in the United States. In normal times most of the ammonia, as sulphate, is consumed as fertilizers; but at present other compounds are necessary and plants are being altered accordingly.

Drilling on the Lena Goldfield, Siberia

By W. E. THORNE

Early in 1915 I was asked by the Lena Goldfields, Ltd., of London, to go to Siberia and organize the drilling operations intended for sampling these celebrated alluvial mines in the Bodaibo region, and to advise as to the possibility of applying either mechanical or hydraulic methods. The cost had been so excessive that it was thought desirable to change the method of operation.

When I arrived I found drills scattered all over the property, which is 250 miles long by 100 miles wide. The company owns 45 Keystone drills, 38 being in operation. Before my arrival about 20 were in use, the others being under repair. Most of them are No. 3 traction; others are No. 4 traction, and non-traction. Each machine was operated as an independent unit, as if it belonged to a separate company. Spare parts and supplies were carried with each machine. If two machines were working even within a short distance of each other, and something should break on one of them, it would be obtained from the main supply-station; possibly the other machine might have the part required, but a transfer would not be allowed. No special reason was given for this, except that the drill-foreman said that he was charged with each separate part, and if he let the other man have it, he would be short. A great deal of time was lost thereby. One of the first things I did was to concentrate the machines, so that never less than two machines were working on the same ground, and as many as six were working within 600 ft. of each other. By so doing, we reduced the number of spares that it was necessary to take from the warehouse at one time. Instructions were given to the drill-men to borrow from each other; all that was required was a receipt from one man to the other. They were instructed to assist each other as much as possible in order to expedite the work. Thus we were able to introduce team-work into the organization—something they had never known before. I asked the drill-foreman and workmen to submit to me any scheme that they thought would improve the efficiency. They were to make a sketch of any change they thought useful, or write me a letter stating their views, and I would take it up with them; it was understood that any good ideas would be adopted, and that they would receive credit for them. This was a thing that they never had been permitted to do before, as they told me that the Russian technical man absolutely refused to consider suggestions from the workmen; he said that, as the workmen were non-technical, it was not possible for them to know what was best.

As a result of this concentration and team-work, our results, at the end of the first year, showed an increase in efficiency of 32%, with no increase of cost. The best record was made during August 1916, when our cost was 59% lower and our speed 55% greater than formerly. This was done under adverse conditions; for the previous season's record was made prior to the War. Some of our best drill-men had been mobilized; also we were short of supplies, and were required to repair and to re-construct a great many badly worn tools, which, under normal conditions, would have been scrapped. In 1917, after the Revolution, the cost increased about 62% and the efficiency decreased 11%; this was due to the exorbitant demands of the workmen, plus the high cost and shortage of material. It became necessary to make our own couplings, shoes, and drive-heads at the mine. These parts cost about four or five times as much as if ordered from the factory. Labor conditions became almost prohibitive. The laborers demanded an eight-hour day with an increase in pay of 105%; they also demanded the right to rest when they pleased, to have extra men on the machine, and to be given time to smoke. As to smoking, they insisted on the right to smoke three times per hour, this consuming 10 minutes. When they did work, it was in a half-hearted manner, as though they knew that their jobs were permanent and that they would not be discharged. We consented because we had no choice in the matter. No discharge of a workman could be effected without passing it first through the hands of two committees, the group and the head committee; then it went to the general manager, but his decisions always confirmed that of the head committee. A lack of backbone, I think, was the reason for this.

The old system of keeping records was very poor. With the aid of my chief assistant, A. L. Matsusovich, we arranged a new system. First came the 'log' or record of each hole; this included all the essential facts in reference to the work, such as depth, cost, character of material, average per cubic yard, and time. These figures were forwarded to my office as soon as the hole was completed; in the majority of cases it was received within 24 hours. By glancing over this sheet, I could ascertain if there was any delay or excessive cost. Every foreman and superintendent had instructions to report once each day by telephone to my office. If there had been any excessive cost or delay, the question was immediately taken up and the reason ascertained. Originally the journal, or day's record, was made in triplicate, written out laboriously by hand by the drill-foreman. He might have to write six before getting three complete copies. This took a lot of his time and was unnecessary. Under my direction he wrote one copy; that came to the head-office, and from it the others were typed and signed by the assistant; one copy was kept in the office and the others

forwarded to Petrograd. In this journal were given the position of the hole, the name of the claim, the depth to bedrock, the water-level, and so forth, even segregating the items of cost, the total cost for each hole, the cost per foot, the average value over the total depth, and the average value over what would be considered drifting depth, usually 7 feet.

The method of calculating average values was what is known as the Radford formula. This, as I understand it, assumes that 100 linear feet of 6-in. pipe, with 7½-in. shoe, is equal to one cubic yard in place. This I changed, using 81 linear feet for the 6-in. pipe. In some parts of the work, I made a reduction of 10%, and in others 25%, for safety. In part of the ground it is impossible to drive the pipe before drilling; consequently it became necessary to drill below the pipe, then to drive, and afterward to pump. This is not the best practice, but under the conditions that prevailed in this part of Siberia, there was nothing else to be done. That is one of the reasons for the use of safety-factors. Subsequently we put down shafts on some of the drill-holes, and also checked the bottom 7 ft. of the drill-holes by underground workings. In a few cases the results did not check. This was accounted for by a boulder coming in before the shoe, and, in drilling ahead of the pipe to break this boulder, sometimes the boulder would be driven down for several feet before reaching solid material where it could be broken. If this happened, then the gold would be carried down with the boulder; as a result the drill-hole would show an enrichment at this point; whereas, when a drift-sample was taken, it would not have such a concentration, and therefore would show a lower value than the drill-hole. Where the conditions were suitable, even in rich ground, the checks were within 2%, which was close enough for the work that was being done. While it is possible that some of the drill-work was carelessly performed, I came to the conclusion that there was more loss from careless washing than in the actual sampling. In some of the old records, I found that they had never taken into account any value under 45 milligrammes per foot of pipe. Of course this old work was ignored and the ground re-drilled. In the new work I had one drill-man check the work that he had done two years before under the old management. His new work showed more gold than the old. This raised a doubt as to the correctness of the last drilling. I asked the drill-man to give me his version of the matter. This he did, by describing the method used; that was to take one pumping from each foot of hole, put it in a grain-bag, which was left on the ground where it became solidly frozen. The samples were taken in a wagon and hauled about two miles to a washing-plant. The bags were placed in a tub of warm water, allowed to remain there for a few minutes, and then were dumped into the washer. Frequently not more than half of the material had thawed, the other half still remaining frozen and adhering to the bag. The bag was shaken over the washer and thrown aside. The foreman told me that bags had been returned to him with fully half the sample remaining in them. As the material was wet when dumped into the bag, the gold would sink through and concentrate at the bottom of the sample. As that was the part adhering to the bag, of course the richer part of the sample was never washed. Hence the discrepancy.

In my sampling of alluvial tin deposits in Portugal and Nigeria, I have had the same trouble with boulders found in front of the shoe; the ground not being hard, the boulder would travel ahead of the shoe, sometimes several feet, before being broken. When broken either rich concentrate was obtained, or the boulder might have been driven a little to one side and the greater part of the sample lost. In one instance, in Nigeria, in a line of holes where the samples had been good, one drill-hole showed an exceedingly low return. The foreman was a good worker, and he knew that the sample coming from the hole was too small. When he came in at night he explained the trouble in detail, and I instructed him to drill another hole about 18 in. from the first. His return from this second hole was about 9 lb. of cassiterite per cubic yard. We then eliminated the old hole and used the new one. The dredging results in Portugal and Nigeria showed a higher return than the drill-tests. This is explained by the fact that most of the tin deposits are loose and the boulders in the material would cause trouble. Also part of the drilling was done with the Empire drill, using the working-pump only. By this method we depended solely on the slosh of material to get it above the ball-valve in the pump. This does not work successfully. One set of drill-holes in Nigeria showed 3.5 lb. cassiterite per yard, and the dredge returned about 5 lb. per yard. This, of course, is on the safe side, but there are places were such differences might be sufficient to condemn a venture. The best way to avoid this inaccuracy is to drill more holes and to use a suction-pump.

As soon as I suggested that possibly some of the Lena ground might be worked more advantageously by dredging, the Russian engineers on the property said it was impossible, because all the gold was in the bedrock. In order to test this statement, I requested A. J. Heindel to make a graphic presentation of the gold in each hole. This he did, and, as we had a cross-section of each line of holes, when the values were shown graphically on this section, one could see where the gold was concentrated. After having completed a few of these it was definitely settled that fully 98% of the gold was above bedrock. Even if it had been on the bedrock, there was no reason why the dredge should not have recovered it, as the bedrock is sedimentary just as in the Klondike and in Alaska.

The drilling machines are numbered. A map on a scale of 175 ft. to the inch was used. On this each line of holes was marked, and also each hole. A pin with a number represented the machine. This pin marked the point where the machine was drilling. If a machine was in the repair-shop, or was being moved, it was indicated by a pin stuck in a card hanging on the wall. There was

a black blank on this card, so that each 24 hours of work could be marked with chalk, indicating every day the site of each machine, and the progress made, so that anyone wishing to know anything in reference to the drills could walk into the room and see at a glance just how things were progressing. This is of great assistance to the office-man, for when some foreman telephones for 'spares' and gives the field-number of his machine, by a glance at the card one can see if it is a No. 3 or a No. 4, and then send out the right spare parts. The sending of the wrong parts was a serious handicap before this system was adopted, as I know of cases where they were sent 150 miles and on arrival were found to be not what was wanted. A tabulated sheet was prepared at the end of each month and sent to my office by each superintendent, giving the total amount of drilling for the month for each machine, the number of the machine, the name of the foreman, and other details. These tabulations were compiled at the end of the year and each foreman was given credit for the work that he had done. A large sheet was prepared from all the records at the beginning of each month for the previous month's work. This sheet when completed was forwarded to the office at Petrograd, copies always being retained for my office.

By this system of cost-keeping we were able to work out an accurate method of distribution of costs. Average costs for the year were proportioned as follows:

	%
Workmen	45.6
Superintendence	9.7
Horses	8.1
Wood	32.9
Material	1.7
Repairs	2.0

The excessive cost for wood was caused by using wood for bonfires, to give light when at work. The winter work was done when the thermometer registered –70° F. I advised the company to operate only about nine or ten months of the year, stopping during the excessively cold weather, meanwhile making such repairs as might be needed. We used manila rope. In the very cold weather this cable would begin to freeze and accumulate ice, until sometimes it was four inches thick and would barely enter the pipe. When it became necessary to lower a string of tools to disconnect the cable, it was like a bar of iron. When it did finally bend, it was usually at the socket; about one-half or two-thirds of the cable would break off, and it was necessary to put the socket on again.

Too many different standards for repair parts were in use; for instance, there were five different sizes of couplings for the 6-in. pipe. This was due to the fact that couplings were furnished partly by the Keystone company and partly by Russian companies; but some of the other sizes were unexplained, until, in talking it over with one of the mechanics who did most of the work at the head machine-shop, I learned that sometimes a pipe that had been much used would be returned to the shop. The threads might be good on the end, but being worn it was of smaller diameter. The drill-foreman would instruct the mechanic to make a new coupling to fit this thread. In consequence, when the coupling was taken off and an attempt made to fit it to another joint of pipe, it would prove too small. I have seen the drill-men attempt to put on a new section of pipe when drilling; they would try every piece of pipe they had and yet be unable to get a good fit. This caused much loss of time. Accordingly orders were given that all couplings must be standardized and all pipe-threads cut to fit these standard couplings. All these standard ends on couplings were marked with a diamond cross, thereby enabling the workmen to identify standard couplings and pipe at a glance. This standardization was not put into effect all at once; to do so would have been almost impossible under the conditions as it would have required at least six months, but it was done as often as a pipe came in for new thread, or when new couplings were made, some of the old couplings being turned to a little larger diameter. Our standard coupling was made by a Russian firm and was slightly larger in diameter than the Keystone coupling. We could turn out the Keystone coupling to a larger diameter, but could not shrink the Russian coupling to a smaller size.

On leaving for the mine, I was advised by some American engineers, who had had much experience in Russia, that it would be impossible to get efficient work out of the Russian drill-men. This proved to be a mistake. Russian mechanics and workmen can do good work and will do it if properly directed. They do not accomplish as much as American workmen, but what they do, in most cases, is well done. As an illustration, in 1913 I was in the same district with five American drill-men and they accomplished about three times as much work as the Russian drill-men. One reason for the lack of efficiency of the Russian workmen is, I think, the lack of practical experience on the part of the technical staff. The Russian engineer has a good technical education, but as for practice or doing things with their hands, from my experience among them I would say that 99% of the Russian engineers are deficient. Of course, having no practical experience, they cannot direct the workmen as they should. The Russian idea is to measure organization and efficiency by the number of men that they have doing a piece of work. A foreign engineer is all right in Russia if he can take over a piece of work and figure out some scheme to put on more men, but if he begins to reduce the force and accomplishes the same amount of work with less men, they immediately begin to raise objections. They believe in doing things by hand labor. I have seen them put a rope on the end of a large 3-in. plank that was water-soaked and very heavy; five or six men would take hold of this rope and drag it for 100 ft. or more. At the same time a horse and cart would be standing idle alongside. The time it would take to attach the rope to this cart and drag the plank to the point where wanted would have been 10 minutes. These five or six workmen would put in at least one-half to three-quarters of an hour getting the plank in place, because they must stop to smoke, and talk, and rest during the process. This operation was the

fault of the technical man in charge; he stood calmly by while the work was going on, seeming not to realize that the workmen were wasting time. One cause for a great deal of trouble in attempting to organize work and to make the workmen understand what is wanted is the inability of a man to speak the Russian language and to understand it. If one depends on an interpreter to translate orders to the workmen poor results are obtained. Usually the interpreter is a non-technical man and has had no practical experience in the work that is being done; therefore he is likely to convey a part of the instructions mixed with some of his own ideas, which is confusing and causes a great deal of trouble between the foreign engineer and the workmen. After an engineer is able to speak the Russian language and can give his orders direct, he will find that his troubles have been greatly decreased.

The production of gold in 1915 from the Leskoie was a little over 18 tons, worth about $9,000,000. In 1916 and 1917 the output was about 16 tons each year, with 7500 to 8000 workmen employed.

Gold stealing is common. The gold is taken to the Government laboratory at Bodaibo. About $2,000,000 worth of gold not accountable to the producing mines is received annually at this laboratory. Government officials say that this is stolen gold; as the Lenskoie produces about 75% of the gold shipped from this district, $1,500,000 of this stolen metal must come from the Lena mines, which produce about 35% of the total Russian output. In 1917 the general manager conceived the brilliant idea of bribing the workmen to be honest. He offered to give them $1,500,000 per anum, to be divided among themselves as they saw fit. This proposition was made to the head committee, the members of which answered that they would take it under consideration. Shortly afterward they came back with a counter proposal that if the company would give them $5,000,000 per year they would not steal any gold. This was not accepted. The company is itself to blame for the stealing. In early days the managers started the practice of paying the workmen a premium for each large nugget turned in at the head office. Of course, the nuggets picked up by the miners became smaller in size, but the premium was still paid. Soon the miners found that they could get more money from some outside buyers; in consequence the company had to increase its premium and the illicit buyers increased theirs, until now the Lenskoie company gets no stolen gold unless it pays the same price as the other parties. Early in 1915 one stolen nugget weighed 18 lb. This was abstracted within 25 ft. of a watchman. The nugget was taken away and sold at Bodaibo; the company knew nothing of it until a miner while drunk gave the tip. It will be impossible to stop this stealing under the present Government.

The present methods of underground work are about what they were at the beginning of operations. A great many suggestions have been made for improving them, but it is difficult to introduce any improvement among people that object to doing anything that their grandfathers did not do. On some of the ground where I advised the use of dredges the unit of calculation is the sajene, which is 7 ft. In driving, each 7 ft. square of bedrock by 7 ft. high costs about $100. The average depth of the ground is 70 ft. The average gold content of this ground when driven is $75 per 7 sq. ft., showing a loss of $25 per sajene. The same work can be done by dredging at a cost not to exceed $25. I showed them by figures that where they were losing $25 there would be by dredging a possible profit of $75. It was a long hard struggle to convince them, but they finally came to the conclusion that I was right. In August 1915 they placed an order for one 17-cu. ft. dredge. This was considered at the board meetings, talked over, discussed, and delayed until November 1916, when the order was placed. During the time they were making up their minds for this change, there was an increase of about 40% in the cost of material, and a doubling of the time required for delivery.

Credit for the technical improvements that have been put into operation during the last five years belongs mainly to Leon Perrett, a Russian engineer, who was general manager in 1913 and 1914. The erection of the new plant was directed by R. E. Smith, an American engineer. Mr. Perrett introduced mechanical haulage, also the recovery of timbers from underground workings and the winter-washing arrangements. The winter-washing was not begun until 1914-15, but Mr. Perrett discussed the idea with me in April 1913. I described our practice at Dawson, and agreed with him that it would be practicable. It has proved all that we could have expected. A mistake was made in the first winter-washing plant, the grade of the sluices being only 4%. The flat sub-angular gravel of these mines will not run in a sluice having so slight a grade. The Russian engineer on the mine objected to the 4% grade but could do nothing, in face of the opinion of the consulting engineer, until an experiment had been made. A. K. Schmidt, a Russian engineer, who was in charge of the Feodosiskey mine, then took over the re-construction and increased the grade to about 10%. The sluices have worked well ever since. In 1914 plans were drawn by the consulting engineer to erect a mechanical elevator on the Tichon mine. This was a complicated plant and proved a failure. In 1914, after an examination and some sampling, I informed the secretary of the company by telegraph that dredging was advisable, as there was no possibility of a profitable operation with mechanical elevators. This created a dispute among the directors, who insisted on sending a special commission consisting of H. M. Payne, A. Gernet, and A. Schwartz to investigate. This commission came on the ground during the summer of 1915 and, after an examination, decided that dredges should be bought forthwith.

SULPHURIC ACID, 66°B., is now selling at $40 per ton. The 50°B. acid, which is absorbed by the fertilizer industry, is quoted at $23 to $24 per ton.

Californian Manganese Problem

By GEORGE D. LOUDERBACK

Manganese deposits are widely distributed in California. They have been found at intervals along the Coast Ranges, in the Sierra Nevada, and in the ranges of southern and south-eastern California.

In the Coast Ranges, orebodies are found only in intimate association with the radiolarian cherts of the Franciscan group, in which they occur fundamentally as interstratified layers or lenses, somewhat affected by secondary alteration and the re-distribution of material in fractures, crush zones, or fault-fissures. Deposits carrying marketable ore have been opened at intervals from Humboldt and Trinity counties on the north to San Luis Obispo county on the south, over five degrees of latitude. In the Sierra Nevada, orebodies occur with the cherts of the Calaveras group, in an association similar to that of the Coast Range ores. Manganese minerals are also found at a number of localities in veins cutting igneous and metamorphic rocks. The deposits of south-eastern California appear to be chiefly vein deposits cutting rocks of various types.

Size of Orebodies. The orebodies are generally small and discontinuous. There are numerous bodies that would yield from 1 to 100 tons of ore, and many that contain from 100 to 1000 tons, also a moderate number with some thousands of tons up to 10,000 or more. The largest producer in the past is said to have yielded nearly 50,000 tons, and is still producing. Previous to the War but little manganese was mined in California; therefore most of the deposits now being worked were then unopened and in part unknown. As hurried work has been done in response to an urgent and supposedly temporary demand, time has rarely been taken to block out ore, or to develop much in advance of the bare necessities of ore extraction. This, combined with the commonly lenticular or otherwise limited form of the orebodies, makes the determination of available tonnage imperfect, a careful estimate being in general much below the probable supply.

Character of the Ores. The chief manganese-bearing mineral in the ores mined to date is psilomelane, with which is associated a subordinate amount of pyrolusite. In many localities manganese carbonate has been observed, and at several properties it is mined as an ore in the lower workings. It is probable that, with more extensive operation, the carbonate will be found at more places, and will be mined in increasing quantity. It is evident that the black ores in many mines originated from the oxidation of the carbonate.

Veins containing the silicate, rhodonite, are found at a number of places in the Sierra Nevada. At a few localities, silicates of manganese have been observed in the Coast Range deposits, but hitherto only in minor quantities.

Impurities that are most undesirable in manganese ores, namely, phosphorus and sulphur, are either low or entirely absent from Californian ores. Iron rarely exceeds 2% in the Coast Range ores, and is usually less than 1.5; it may rise to 3% or more in the ores of south-eastern California. Calcium in small quantities occurs in some of the carbonate ores of the Coast Ranges, and may reach 5 or 6% in a few of the south-eastern ores. In the Coast Ranges and in the Sierra Nevada, silica is the chief impurity, and practically the only one that demands consideration. Mixtures of silica with manganese in oxidized compounds range from zero to 100% of either constituent; 10 to 20% silica is a common range for the high-manganese ores containing 40 to 45% of that metal. In the ores of south-eastern California, silica is less in evidence, running from 1 or 2 to 10 or 12%, and the ore is more likely to be associated with calcite, barite, and fluorite.

Practically only the higher grades of manganese ore (38% and over) have been marketed in California. Associated with the high-grade ores in many cases are streaks or larger bodies of lower grade assaying from 25 to 38%, as well as ores that, though fairly high in manganese, carry 20 to 40% or more of silica. These are generally left in the ground, or are treated as waste, although of late some ores with over 20% silica have been marketed. It seems probable that a satisfactory method of concentrating these ores, or of otherwise utilizing them, would more than double the available manganese in many deposits, and make it desirable to open deposits that now are unprofitable. A study of methods of concentrating manganese ores, with special reference to the Californian problem, has been undertaken at the University of California under the direction of E. A. Hersam. His preliminary report will soon be available. The U. S. Bureau of Mines has also established a station in Minnesota for the investigation of problems connected with the production and utilization of manganese.

The Problem of Development. The fundamental difficulty in promoting manganese production in California lies in the small size of many of the deposits and in their broad distribution. Scattered small holdings can hardly appeal to capital. To obtain large production, much of the available ore must be mined by the small miners, the farmers, or others who may not have had previous experience in the work. The owner of a small property ordinarily cannot afford to open and develop it much beyond the actual producing face; he cannot store sorted ore piles for shipment in carload lots; he cannot

maintain an expert engineer, geologist, or assayer, and he usually is not familiar with the marketing of the ore. He cannot contract to supply in the future a definite tonnage or a definite grade of ore. This makes it difficult for him to do business with the steel or alloy manufacturers direct, and he either finds it impossible to dispose of his product, or must depend on brokers for sales. The brokers' method of doing business generally has not been conducive to increased production. Individual bargaining, leading to different prices offered to different producers, even in the same district, has created a feeling of unfair treatment or discrimination. Complaints have been made also of long delay in securing payment, and even of non-acceptance of carloads shipped to the East at the expense of the producer, because some grade-limit was transgressed. The small producer cannot tide over such delays nor afford such losses; hence his production ceases. These difficulties could be met largely by the establishment of buying agencies in touch with the field. Although there are many isolated properties, it is also true that many are grouped in limited districts. An agent at a convenient point in each district, provided with storage-space where ore could be delivered as produced, could make a preliminary inspection, weigh, sample, and pay spot cash for a reasonable percentage of the estimated value, the balance to be paid on final assay returns. Ore could be bought in ton lots or more, sorted into grades, and shipped when sufficient quantities of determined grades had accumulated. Ease of marketing, cash payments, and definite price-schedules would stimulate production from small properties. Buyers then would be protected as regards grade of shipments, and all would be benefited.

The pre-war eastern prices of manganese ores ranged from $8 to $13 per ton. Freight to eastern points is from $12 to $15. Aside from the freight, the cost of mining and laying down at a railroad point has been, for most properties in California, greater than the final price that could be obtained. It is not surprising that there was practically no production before the War. The effect of the War is shown by the rise in production from nothing in 1913 to 150 tons in 1914, to 4013 in 1915, and to 13,404 tons in 1916. If the pre-war prices return, most, possibly all, of the mines must shut-down. As far as the Pacific Coast States are concerned, the mining of manganese is mainly an emergency industry.

Suggested Remedy. A guaranteed minimum price for a reasonable time would justify an initial outlay for the development of many properties. Such a guarantee would encourage the small holder, would bring in capital for the larger properties, and would stimulate prospecting. I understand that Great Britain has given such guarantees to certain of its mineral industries, assuring a minimum price for two or three years after the end of the War. It is probable that here a Government guarantee of a minimum price for two years, war or no war, would be sufficient to cover any necessary outlay.

If manganese production, under normal conditions, only needed business organization to make it a stable industry for a few years, it would seem best that an effort should be made to induce private capital to establish such an organization, but it appears that the bulk of the manganese production that might be developed by proper organization and encouragement in the Pacific States must be considered as a war-emergency industry, and the effort and cost of organizing it may not appeal to private enterprise. Its organization by the Government, or through some authorized public agency, would seem to be the surest and best solution, as it sustains the confidence of the prospectors and producers.

Heating of Coal in Piles

By C. M. YOUNG

*Bituminous coal piled in heaps or bins tends to heat spontaneously through the absorption of oxygen. It seems probable that the first absorption of oxygen by coal which has not previously been exposed to the air may occur as a condensation of oxygen in some form which does not produce carbon di-oxide. The absorption of oxygen is accompanied by an increase of temperature, and this in turn accelerates absorption, and so on, until the kindling point is reached. A dangerous rise of temperature can be prevented by excluding oxygen, by increasing the bulk of coal in proportion to its exposed surface, or by circulating enough air to dissipate the heat produced.

The size of the coal is important, for, if the lumps are small, the spaces between them constitute a small percentage of the total volume, and little oxygen will be available unless circulation of air brings a fresh supply. With large lumps the percentage is relatively large, and circulation also is much easier. Attempts have been made to prevent heating by circulating sufficient air to remove the heat generated, but this method cannot be applied to fine or mixed sizes. At the University of Illinois an attempt has been made to use so much fine coal, and to pack it so thoroughly, as to prevent circulation of air through a pile to prevent heating. The method has been fairly successful. Investigations made on opening such piles showed that the portions in which fine sizes were present in largest proportion did not contain sufficient oxygen to heat the coal to any noticeable extent. The close packing had also obstructed circulation so that little fresh oxygen could have been brought in even if the temperature had been raised to such an extent as to favor circulation of air. This indicates that one comparatively safe way to store coal is to use enough of the fine sizes to fill the interspaces as completely as possible, and to pack the coal tightly in order that the air space may be reduced and the circulation of air restricted.

Membership of American Federation of Labor has grown from 50,000 in 1881 to 2,371,434 in 1918.

*Abstract: Article to be presented at February meeting of A. I. M. E.



NEW YORK

Financial.—Taxes.—Commandeering Platinum.—Daylight Saving.

The financial situation is a reflection of the Russian situation and is influenced, moreover, by the definite prospect of a Liberty Loan issue in the near future. Japanese bonds have recently reached a new low record for the year, after having appreciated in value steadily since 1914. Up to the present time Japan has made huge profits out of the War and has used these profits, in large measure, to retire Government bonds. If the country takes a more active part in the War it is likely that all the available capital will be needed for the prosecution of a vigorous anti-German campaign in Siberia. Hence the lack of support toward Japanese issues during the past week. Liberty 4's remain around 96, and show no indication of responding to the consideration that they will, in all probability, be convertible into the forthcoming new issue at par. The maintenance of a comparatively low price-level in these bonds is attributed to extensive selling by some subscribers to the last loan who are anxious to demonstrate their financial ability to take up the new issue in even greater quantities. To do this they are obliged to liquidate their present holdings. All Liberty Loan bonds have therefore declined during the past week. The question of eliminating the $50 and $100 denominations in the next issue has been frequently discussed, and it has been pointed out that the investor with limited means at his disposal can invest in Thrift-Stamps and War-Savings Certificates. In spite of extensive publicity, the soundness of the War-Savings Certificate scheme is not appreciated or understood to an extent that it might be; if this were realized it is doubtful if small investors would buy Liberty Bonds at all. Up to $1000 can be invested in War-Savings Certificates and, unlike the Liberty Bonds, there can be no market depreciation of capital value. The interest accruing compares favorably with that of the last Liberty Bond issue, and few will object to the fact that this is payable at maturity rather than in semi-annual instalments. An additional feature in favor of War-Savings Certificates is that these are redeemable at any time before maturity (January 1923) for the full amount paid, plus 3% interest, the redemption being done by the Government without expense to the investor. Considering the security, the conditions are favorable and even attractive, and it is therefore somewhat difficult to see the reason for the issuance of Liberty Bonds in small denominations, maturing at some far-distant date, when War-Savings Certificates would seem to already cover this particular field. As long as the Government obtains the necessary funds to continue the War, it is immaterial as to whether investors hold War-Savings Certificates or Liberty Bonds. As the former are more easily negotiated and do not depreciate by open marketing, it may be deemed an unwise policy to overshadow the advantage of investment in them by making expensive efforts to induce the investor with small income to subscribe to Liberty Bonds. If this type of subscriber is to be encouraged the new loan must mature within a reasonable date, so that depreciation in capital value will not occur to the extent it has with previous issues. The security behind Government issues is recognized as unquestionable, but there is no particular reason why war loans should not possess one or more features of financial attractiveness. If this were so it might be possible to reduce the initial expenses connected with the insuring of subscriptions. The attractiveness of the Savings-Bank system must not be overlooked. In New York State alone about sixty of such institutions paid nearly 4% on deposits during 1917, this comparatively favorable rate being largely responsible for the fact that the total deposits were maintained at two billion dollars, as estimated on December 31. In the matter of the cost of placing the next loan, New Yorkers are interested in a proposal to cut up part of Central Park to represent a mimic battle-field. An appropriation of $25,000 has already been made for the purpose of replacing the sod after the damage has been done, although it is generally admitted that this will only cover a fraction of the expense involved. Whether anyone will feel disposed to purchase a bond after viewing the results of such an apparently unnecessary expense and waste of labor in this time of great national emergency, is open to question. The ratification of the Russo-German peace treaty was followed by a moderate rally in the valuation of Russian bonds, a happening that apparently indicates the value, in financial circles, of 'peace at any price.' Anglo-French and British bonds, uninfluenced by the prospect of additional issues in this country, have hardened and show appreciable rises.

The tax-rate for New York City shows a considerable increase over last year's levy. The budget for 1918 calls for a total of $239,023,759. Toward this amount the county dues amount to $7,400,523, and $38,233,017 is estimated as the probable revenue from the general fund. The balance, $193,390,208, must be met by taxation on real and personal estate representing an aggregate valuation of $8,591,057,726. Nearly three-quarters of the entire city's taxation will be met by the borough of Manhattan.

The commandeering of platinum by the Government has brought home to part of the jewelry manufacturers the fact that 'necessity'—especially military necessity—'knows no law.' The first result of the order has been a brisk demand on the part of the public for platinum jewelry of all kinds, and the remaining stocks will soon be disposed of. Platinum is irreplaceable as a satisfactory mountant for white diamonds. This is largely on account of its non-oxidizing properties, and the ease with which it may be worked in the pure state. Its proximity to a brilliant adds lustre to the latter, and no effective substitute is known. Gold alloys, carrying even 25% of base metal exclusive of copper, invariably have a green shade, a color altogether unsuitable for white diamond mountings. The local refiners are now busy on a substitute for platinum, and it is probable that the Government order may stimulate research which may lead to important discoveries.

No more efficient or less harmful method of economy was ever proposed than the daylight-saving plan which, it is earnestly hoped, will soon become law. It is strange that the scheme has found so few enthusiastic sponsors, although not remarkable that no dissentient voice has been heard—for the advantages to be gained are too obvious to warrant more than passing comment. The merits of the

scheme have been obscured or 'damned with faint praise' to an extent that suggests the obvious inference that 'daylight saving,' as a financial gain to anybody, was not worth advocating, much less exploiting.

The suspension of work at the largest smelter in Mexico—the Aguascalientes plant of the American Smelting & Refining Co.—is announced as due to the arbitrary taxation demands made recently by the State Government, which apparently fails to realize when it is well off. For once a company strikes and 2000 Mexicans are idle. It is thought probable that the prompt refusal of the A. S. & R. Co. to consider the imposition will cause the authorities to modify their demands, who may see in the idleness of their countrymen an additional reason for an equitable agreement.

DENVER, COLORADO

Accidents in Colorado Mines.—Manganese Production.—Colorado Fuel & Iron Co.—Oil-Shale.—Molybdenite Mills.—Flotation of Dump Ore.

According to a statement by Fred Carroll, State Commissioner of Mines, metal-mining accidents are on the decrease in Colorado, although the betterment is slight. Against fatalities f 67 during 1916, the 1917 death-list was 58. The greatest hazard continues to be from falls of rock, with falls down shafts second in point of danger. Of the total 1781 accidents last year, only 703 required the victims to be absent from work more than 14 days. When it is reflected that many inexperienced men have, owing to war labor conditions, become miners recently, these statistics are encouraging for still better conditions this year.

Anticipating action by the War Minerals Committee at Washington in raising the prices of manganese ore, the Colorado Metal Mining Association has inquired why this State has not been more active in the winning of this mineral, and finds that the sole reason for the backwardness has been the ridiculously low prices purchasers will pay for the ore. Miners have become tired of producing manganese when the chances for profit are but a few cents per ton and are frequently in red ink. They will respond promptly to any encouragement given them in the way of fair prices. The Association has been informed that it will be duly advised by the War Committee when it fixes prices for not only manganese but for tungsten, vanadium, and molybdenum ores, all of which can be produced in fair quantities in this State whenever a profit is assured.

It is the conclusion of the oil-shale men in Colorado that future filings on these shales will be regulated precisely as are filings on ordinary oil-lands, that is, by the provision of sections 16 and 17 of the Walsh-Pittman bill, which has passed the Senate and is expected to become a law within a short time. According to this bill, all persons who have already initiated oil-shale claims under existing placer laws and who proceed regularly to develop such claims will not be molested. The bill further provides that all bona-fide locators of such claims who choose to do so may surrender their rights to the Government and be given prospectors' permits with priority privileges for leasing the same tracts under the stipulated one-eighth royalty. A severe test will probably be applied to all locations of such land prior to the passage of the bill and no person who can be proved guilty of fraud will hereafter be entitled to any benefits under the new law.

Pueblo.—The last semi-annual report issued by J. E. Welborn, president of the Colorado Fuel & Iron Co., states that, although the number of employees has increased but 15% in the last two years, the average wage paid has increased more than $200 per year, this being the result of the advance in salaries and wages put into effect last November and amounting to approximately $2,500,000 per annum. The increase in pay does not affect officials. During six months the company mined 407,714 tons of coal, produced 409,483 tons of coke, quarried 219,653 tons of limestone, smelted 196,902 tons of pig-iron, and manufactured 232,888 tons of finished iron and steel products in its Minnequa plant near Pueblo. Receipts for the half-year period were $20,739,030, and expenses $17,029,735. By adding income from sources other than operations, the net income was $4,123,875. The surplus, after deducting all fixed charges, was $2,678,289. Of the $1,000,000 subscription placed for the second Liberty loan, this company was allotted $612,000.

Leadville.—The two mills of 250-ton capacity each, which have been under erection this winter by the American Metal Co. and the Molybdenum Products Co. at Climax on Fremont pass, are practically finished. These companies own property close together at an elevation of about 11,300 ft., the orebody being a great mass of porphyry carrying about 1% molybdenite. A third company is opening another near-by property with the intention of treating its ore in the plant of the Pingree Mines Co. at Leadville, which is only a few miles to the south. In all these properties the mineralized rock outcrops and can be mined by open methods during the summer. To provide tonnage during winter, adits are being driven into the formation. Particulars regarding the MacCarthy process, to be used in the Molybdenum Products Co.'s mill, are kept secret. The American Metal Co. flowsheet includes crushing, grinding in ball-mills, flotation in Callow and Janney machines, and dewatering of concentrate in a Portland filter.

Georgetown.—The Colorado Central is pushing construction of its plant at Georgetown to handle 1000 tons daily from the dumps of the Ocean Wave and Marshall Tunnel mines. Investigations of these dumps show the former to contain 59,000 tons running $4.35 in silver, lead, and zinc, with 176,000 tons in the latter dump running $3.15 in the same metals. The gold content is negligible. It is also estimated that these old mines contain approximately $5,125,000 in low-grade stuff filling old stopes and standing unbroken. The crude dump-rock is first crushed, picked by hand, and screened, this being in the nature of crude concentration in the ratio of 5:1. The mill proper takes this selected feed and passes it through Colorado Iron Works tube-mills and over Deister-Overstrom tables, the reject from the tables going to four specially designed 6-cell flotation machines. The mill will probably not be completed for three or four months. Henry Kroger is president; C. L. Woods is vice-president; and E. S. Wiard is consulting engineer and manager.

ELY, NEVADA

Labor Troubles.—Manganese and Oil-Shale.—Aurum District.

Weather conditions have been bad during the past month. On account of rain and snow roads are soft and no hauling of ore has been possible, except by the large companies who have rail facilities. There has been no coal shortage for two months.

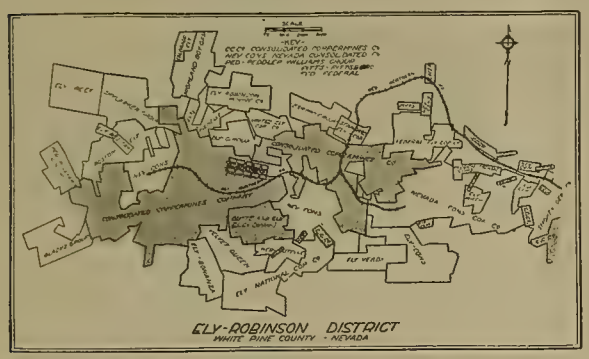
At the Nevada Consolidated Copper Co.'s mines, mill, and smelter, employing about 3000 men, there have been some labor troubles during the past month. Men demanded an increase in wages because of high cost of living. The company at the mines, until February last, has charged its employees only $25 per month for board, room, light, and fuel; nor has there ever been any cause for complaints concerning the quality of board or quarters. But the board expenditure finally rose to $32.55 per month per man, and the company raised its charge to $30. The company advanced wages 25c. per day per man, except for common labor, and paid all of them this rise on the March pay-day for past two months—January and February—which was

delayed until March 11, as a new roll had to be made out. Then the different unions began quarreling among themselves. Some said that they were entitled to more than others. Carpenters stood out a long time, but it is thought at present that their troubles are over for a time. The Ruth mine has its daily production up to 3500 tons. All the Nevada Consolidated mines are yielding 1400 tons daily, steam-shovel operations supplying 10,500 tons. Since the large new crushing-plant was finished last fall there has been little trouble with ore freezing in cars and bins, because there is sufficient storage capacity to dump it from cars in three to four hours, while the crushers handle any size pieces.

Since the above was written, we learn that the rise in price of board was not put into effect. Also, firemen, enginemen, and switch-men struck on March 19, stopping steam-shovel work. Ruth mine continues to work. The mill is working at less than half capacity, due to shortage of ore.

Robert M. Linton, general manager and consulting engineer of the Consolidated Coppermines Co., has been in the district for some time recently. The 1000-ton plant at Kimberly was started early in March.

Holmquist and Bowen, working a manganese deposit 7 miles south-east of East Ely, are only doing development.



All of their workings are full of broken ore, which cannot be hauled owing to bad roads. Three different openings in limestone at 30 ft. depth have exposed large bodies of shipping-grade ore, 40% or better, each several hundred feet apart. At depth of 60 ft. in one shaft, they have a good deal of 60% ore.

The Ward mine, across the valley, 8 miles of the manganese deposits, at an elevation of 8000 ft., is only being developed because of bad roads. Owners could easily ship 100 tons daily indefinitely, but cannot transport it. They would probably put down a narrow-gauge railroad with Holmquist and Bowen, for shipping their manganese, if equipment could be procured.

The Lucky Deposit mine at Aurum, in the north-east part of White Pine county, has been examined by the U. S. Smelting Co. and others. This is a copper property from which Gilmore brothers shipped a number of cars of 8% copper and $6 gold and silver ore, from Currie, last year. They had a haul of 60 miles by auto-truck, but there is a new spur put in three miles below Cherry Creek station, on the Nevada Northern railroad, and by hauling over Shellbourne pass, when roads permit, the distance is cut nearly a half. The property is said to be opening well.

A recent discovery of oil-shale in Steptoe valley is peculiar. When freshly broken, or scratched with a knife, a distinct odor of gasoline is noticeable. Shale is white, crystallized, and largely silicious, from the metamorphic action of the intrusive rhyolites through the shale. Pieces put in the fire explode with considerable force. Some locations have been made.

More patent work has been done during the last year throughout the county than for several years. The present administration of the Land Office, under a Western man's management, who is familiar with conditions, is more liberal than for years past.

SUTTER CREEK, CALIFORNIA

Principal Operations in Amador County.

Amador City.—The Bunker Hill Mining Co. recently levied an assessment of 10c. per share to provide funds for extensive development, including, it is understood, the sinking of the shaft and opening of new levels. This mine has a good record and there is no doubt as to its value in depth, but development is necessary to make it a dividend-payer again. Until the strike in 1916, the Bunker Hill mine had not missed a single monthly dividend for about ten years. Considerable money was spent last year in straightening a bend in the lower part of the shaft, also preparing to sink below 2400 ft. C. E. Bunker is general manager, and W. F. Detert, E. C. Voorheis, Arthur Goodall, and C. L. Culbert are directors.

Jackson.—The Argonaut mine made another fine run in February, the clean-up from the 60-stamp mill yielding about $85,000. This property adjoins the Kennedy, and includes what is known as the Kennedy Extension property. N. S. Kelsey has charge of operations.

Sutter Creek.—Old Eureka Mining Co. has been engaged for the past week in cutting a station on 2200-ft. level. When the timbers are in place and ore-chutes built at this depth, sinking will be resumed 1000 ft. below the former bottom at 2165 ft. before commencing extensive development either in the new ground thus opened or levels above.

The plant of the Oneida mine, controlled by the South Eureka company, is being dismantled. Track and pipe are being removed from the shaft. Levels connecting this mine with the South Eureka will be bulkheaded so that pumps in the South Eureka shaft will not have to lift more than the water produced by the Central Eureka and South Eureka mines, which are at present kept free from water by means of a joint pumping installation in the South Eureka shaft. In the event of the South Eureka mine discontinuing pumping operations, upon notice being given in accordance with contract, the Central Eureka company will assume the expense of keeping the two mines unwatered. The South Eureka company will now dispose of some of its machinery. It is improbable that mining or development will be resumed there until after the War, as present conditions render operations unprofitable on ore opened in the South Eureka.

The Central Eureka company's shaft is being deepened. Two crews of four men each are working under contract. The shaft has reached a depth of 3490 ft. After providing a sump, a station will be cut on the 3500-ft. level, before sinking deeper.

MINNESOTA

Exploration Near Keewatin on Mesabi Range

Keewatin.—Drills of the Carlson Exploration Co. on Mesabi range, which have been operating on the forty west of Keewatin for more than a year, have been removed to Virginia. No more drilling will be done on this property for the present. It has been known for some time that there was a deposit of iron here, and drilling has been carried out in a systematic manner to determine the amount, grade, depth, and shape of the orebody. Many of the holes were placed at 50-ft. intervals to accurately determine the shoreline and limit of surface stripping. This property has been leased by the Wisconsin Steel Co., and it is expected that important operations will be started shortly. The ore developed has shown strong possibilities for both underground and open-pit methods.

THE MINING SUMMARY

ARIZONA

Ajo.—New Cornelia company on March 7 had a successful blast set off. There was 50,500 lb. of 40% Trojan powder charged in 8 holes. Estimates place ore broken as 200,000 tons.

Bisbee.—Wolverine & Arizona produced 1200 tons of 5½% copper ore in February. Of this, 90 tons came from old oxide stopes at Higgins end of property, and averaged 9%. Main workings are near White Tail Deer mine of Copper Queen. No. 2 shaft is down 340 ft., and is being deepened. Cash on hand amounts to $100,000.

Clarkdale.—Poston & Blumfield of Colorado Springs have acquired some copper claims in the Squaw Peak district, on the Mesa-Clarkdale railroad. A camp is to be erected and operations commenced at once.

Globe.—Globe Dominion Copper Co. is to install pumps to lift five times present flow of water. The machinery has been purchased.

Jerome.—Green Monster has developed considerable 1½ to 2% copper ore in its Cliff claim. A winze is being sunk below 400-ft. level to prospect the contact further. Some low-grade copper-silver ore has also been found at 500 ft. depth in the Revenue claim.

Oatman.—United Eastern in February produced gold worth $146,500 from 7040 tons of ore. Average was $20.80 per ton, and extraction 96.91%. Profit amounted to $88,750.

Parker.—Water-level has been reached at 640 ft. in shaft of Empire Arizona Consolidated Copper Co. Cross-cutting will be commenced at 200 ft., as soon as shaft reaches depth of 700 feet.

American Eagle property has been purchased by W. H. Thorpe and associates and a lease obtained on the Roberts claim.

Prescott.—Copper Valley Mining Co., recently incorporated, which took over the old Ehle claims in Skull valley, has commenced operations. The 75-ft. shaft is to be sunk to 500 feet.

Sale of Buzzard and Raven claims to an Eastern syndicate is creating considerable interest in the district. J. B. Tomlinson is in charge.

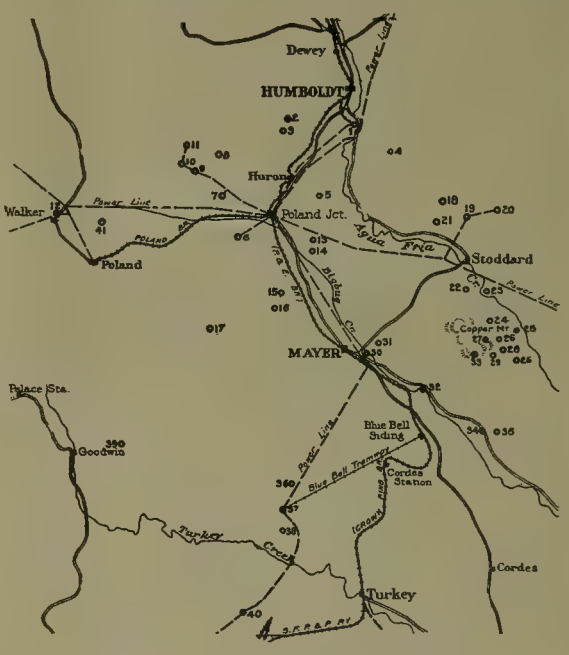
Tombstone.—Huert company has just completed a plant for treating tailing from old Contention dumps.

Compressor and other machinery is being installed on property adjoining the Broskaw claims. A mill is to follow to treat vanadium ore, which is claimed to have been discovered in large quantities.

Tucson.—Arizona-Tonopah M. & M. Co., in charge of George Ankers, has acquired Gold Coin mine in Pinan district, Riverside county, California. Mill is to start treating ore at once. In its Arizona mine, 8 miles south-west of Tucson, 12 ft. of 4% copper ore has been opened. Company controls 994 acres in the two States.

Wickenburg.—Hand-jigs at the old Smith wulfenite mine, 12 miles north-east of here, are producing concentrate. One, working 8 hours, yields 300 lb. of 5% MoS_2 concentrate in the apron, and 50 lb. of 25% product in the basket of the jig. G. E. Johnson Jr. is owner of this molybdenum mine.

Mayer.—In the March 'Yavapai,' a monthly published at Prescott, mining in this district receives considerable space. We reproduce a map showing the more important properties. At Humboldt, the Consolidated Arizona Smelting Co. employs 600 men, producing 2,000,000 lb. copper monthly. The Arizona-Binghampton Copper Co. at Stoddard has developed a large property, and concentrates 5000 tons of ore per month, sending product to Humboldt smelter for reduction.



MAP OF MAYER DISTRICT, ARIZONA

1. Con Arizona Smelter
2. Silver Belt
3. Arizona National
4. Loma Verde
5. Swindler
6. Butternut
7. Henrietta
8. Gladstone-McCabe
9. Little Jessie
10. Lelan
11. Locey-Pabst (Union)
12. Mudhole
13. Boggs
14. Iron Queen
15. Arizona Copper Mining
16. Hackberry
17. Big Reef
18. Moscow
19. Arizona Binghamton
20. Copper Queen Gold
21. Arizona Copper Hill
22. Half Moon
23. Rio Tonto
24. Copper Mountain Mines
25. Copper Age
26. Big Bug
27. Jerome Copper
28. Miner
29. Monte de Cobra (Barbara)
30. Great Western Smelter
31. Little Egypt
32. May Ore Purchasing Co. Smelter
33. Easy Boss
34. Pocahontas
35. Iowa
36. May
37. Blue Bell
38. Cinderella
39. Circle Park
40. De Soto
41. Amulet

ARKANSAS

Yellville.—Activity continues in the zinc-lead districts of northern Arkansas, in spite of long haulage and cost of

supplies. South-east of Yellville the Cowan Barrens Development Co. has started drilling.

Zinc.—Four custom mills are kept busy here, and mines are reported as opening well.

CALIFORNIA

Oil production of this State in February amounted to 272,667 bbl., against 270,990 bbl. in January. There were 8158 wells producing. Completed wells were 51, with an initial yield of 11,090 bbl. In Montebello field Standard Oil Co. brought in its Baldwin No. 6, with 2000 bbl. daily, and No. 11 with 1000 bbl. Stocks decreased 412,087 bbl. to 31,360,378 barrels.

The State Mining Bureau of San Francisco has published Bulletin 77, entitled 'Catalogue of Publications of the California State Mining Bureau, 1880-1917.' With index it covers 44 pages. Brief notes are given on each bulletin published, also whether it is in stock or not.

Bolinas.—Four miles from this small port on the coast of Marin county the Chetco Mining Co. is operating an interesting copper property. It was first worked about 40 years ago; again in 1903, being finally re-opened late in 1917. The vein occurs mainly in metamorphic sandstone, although partly in a shale. Ore is found as shoots, it being an impregnation. It is a sulphide right to surface. The copper mineral is chalcopyrite. Openings by shaft and tunnels to 200 ft. depth amount to 2000 ft. A good quantity of ore has been developed. Shipments over 300 tons have averaged 9% copper and 9 oz. silver per ton. A 40-ton mill was started this week. It consists of crusher, Hendy ball-mill, and Overstrom concentrator. Ore being dressed carries 4% copper and 1 oz. silver for each 1% copper. A concentrate containing 12% copper is aimed at. No classifying is necessary. An extraction of 90% is expected, according to tests. Concentrate is to be hauled to Bolinas bay, loaded on schooners, and carried to the Mountain Copper smelter at Martinez on San Francisco bay. About 25 men are employed, in charge of Theodore R. Heintz as manager and D. Walter Carr as superintendent.

Grass Valley.—Golden Center company has decided to levy an assessment to finance deeper development. This action was taken at a meeting of shareholders at Sacramento. C. A. Brockington will continue as superintendent. E. C. Uren has been appointed consulting engineer.

Idria.—New Idria Quicksilver Mining Co. notifies stockholders, for purpose of income-tax returns, that the $1 dividend paid March 31, 1917, was wholly from 1917 earnings; $1 paid June 30 was 47c. from 1917 earnings and 53c. from earnings prior to March 1, 1913; 50c. paid October 1 and 50c. paid December 29 were wholly from earnings prior to March 1, 1913.

Ingot.—Afterthought Copper Co.'s roasting and flotation plant have been in operation 20 days, and are stated to be making a high extraction. About 150 tons of concentrate is produced daily. There are 125 men employed, 40 being at the mine. Numerous cottages are being constructed for employees. Six motor-trucks are to be used in transportation of supplies and concentrate.

Los Angeles.—Tonopah & Tidewater Railroad traffic department announces that it will aid in bringing to the attention of manufacturers and capitalists any desirable undeveloped mineral resources along its line. Analysis will be made free of charge, provided samples justify the expense.

Walker.—Klamath River Dredging Co. has started prospecting an extensive area of promising placer ground in this district. It is improving its dredge. Adjacent territory has been taken under option. J. R. Wade is superintendent.

Sutter Creek.—Old Eureka Mining Co.'s statement of September 17, 1917, shows the following expenditure to that date in re-opening this mine:

Item	Cost
Construction and improvement	$71,735
Tools and equipment	3,756
Pumping and shaft repairs	117,657
Taxes	1,771
Mine development	3,849
General operating charge	19,415
Purchase of 111 acres adjoining	10,211
Total	$228,394

Cash in California and New York totaled $41,769; and supplies $9687. Future plans are to push development in drifts and sink main shaft. As far as sunk, south side of shaft has been stoped, but none on north side for last 150 ft. Vein is mixed with slate and gouge for 5 ft. between walls. Management is highly optimistic as to future.

Winthrop.—The Arnstein syndicate has completed arrangements for diamond-drilling the Bully Hill mine to depth of 1200 ft. Excellent ore has been developed on the 900 and 1000-ft. levels of the Rising Star shaft. Shipments to the Kennett smelter have been increased to 125 tons per day.

COLORADO

Georgetown.—W. J. Chamberlain Ore Co. has decided to close its sampling-works here, also at Breckenridge and Blackhawk. They will be dismantled. Lack of ore and concentrate, and high cost of operation, caused this step. The Idaho Springs sampler will continue to receive ore.

Rich silver-lead ore has been opened in Georgetown adit in Columbia mountain.

Denbigh Mines Co.'s Terrible mine is shipping three cars per week of high-grade silver-lead ore. Thirty-three men are employed.

Hollingsworth Mining Co.'s Smuggler mine continues regular shipments of zinc-lead ore. Development is reported as good.

IDAHO

Adair.—Montana-Idaho Copper Co., which has been driving an adit for two years, reports that it has cut what is considered to be the Monitor vein at 3865 ft. Ore is 10 ft. wide, carrying copper in small quantity. The Richmond vein, 300 ft. farther on, is to be cut by extending the adit, which is in 4275 feet.

Kellogg.—Caledonia Mining Co. pays 3c. per share, equal to $78,150, on April 5.

Kelton.—Melcher Mining Co. will start its new 100-ton concentrating plant, including flotation, early in April. Mine said to contain large low-grade orebodies. Shipping ore assays 29 oz. silver, 41% lead, and 2.7% copper. Property is 55 miles north of Kelton in Stokes district of southern Idaho, also 24 miles from Delco, nearest railroad point. Pere McIntyre is superintendent.

Kingston.—Hypotheek Mining & Milling Co. has levied an assessment on account of adverse circumstances—local—and price of lead. Indebtedness is $20,000. Recent development on 900-ft. level has opened 8 ft. of ore, nearly equal to the shoot at 700 ft. Ore is being shipped.

Mullan.—Flynn property, near Morning mine of Federal M. & S. Co., has been sold to Edward Ehrenberg and others of Spokane for over $500,000. Little development has been done, but prospects are considered extensive.

Federal Mining & Smelting Co.'s quarter ended January 31, 1918, shows a loss of $193,525, after deducting $25,757 for depreciation. A year ago there was a profit of $316,164 in this period.

In suit of Federal M. & S. Co. v. Star Mining Co., for alleged trespass and removal of a large quantity of ore, original suit started and won by Star company in 1917, the Federal company won last week in Federal Court at Wallace.

Salmon.—Northwestern Development Co., of Boise, Idaho, is operating the Ranger copper claims, 12 miles east of Salmon in Lemhi county. New York people worked the property for gold in the 'eighties, but lost 60% in the tailing. They spent $260,000 in all. Copper was a detriment to treatment at that time. From 1883 to 1917 the mine was full of water, when present company obtained control. By September last unwatering was complete. Examination showed an ore-shoot 320 ft. long, averaging 4 ft. wide, worth $40 in copper and $50 to $75 gold per ton. This shoot had been developed by a shaft 150 ft. deep, ore had been stoped to a depth of 100 ft. from the surface, leaving 50 ft. of shaft in ore with a drift running from the bottom exposing ore mentioned. After examination workings were allowed to fill with water again. A survey was made and a tunnel-site located so as to cut the vein at a depth of 650 ft. Work was immediately started on the Ashland adit, supplies and equipment were stored on the mine, and work has been done all the winter. This 800-ft. adit will serve a double purpose—drainage and transport of ore to the top of a mill to be erected adjacent to property. Dumps contain 10,000 tons of $10 gold-copper-silver ore. When ore worth $500,000 is blocked out a concentrating plant will be erected. Hydro-electric power can be developed nearby. Ore appears to be amenable to flotation.

MICHIGAN

Houghton.—Calumet & Hecla plans completion of 10,000-kw. power-plant at its works on Lake Linden. Finish of the new office is the only construction that this company contemplates this year. The new hospital at Calumet will not be erected until after the War.

Calumet & Hecla Mining Co. reports as follows:

Mines	February, lb.	Two months
Ahmeek	2,029,893	4,125,381
Allouez	643,426	1,381,205
Calumet & Hecla	6,137,485	12,248,589
Centennial	204,568	468,001
Isle Royale	1,148,129	2,186,691
La Salle	136,877	287,840
Osceola	1,408,457	2,717,990
Superior	146,070	325,907
White Pine	222,418	475,916

MISSOURI

Joplin.—Production of Missouri-Kansas-Oklahoma region last week was 7393 tons blende, 300 tons calamine, and 1622 tons lead, averaging $51, $35, and $84 per ton, respectively. Total value was $523,922, making $5,137,077 for 11 weeks.

MONTANA

Butte.—East Butte Copper Co. produced 2,324,000 lb. in February. About 40% is from custom ore. Flotation plant is treating tailing averaging 1% copper, recovering 0.8%. Dutton mine is contributing 11% ore for smelter. From 1500-ft. level of Pittsmont mine 5% ore is being extracted. Company proposes to sink a new shaft west of main at the Pittsmont mine.

Troy.—Snowstorm Mines Consolidated reports that milling started in April 1917, and to end of year 61,647 tons of ore yielded concentrate containing 340 oz. gold, 70,075 oz. silver, and 3,364,439 lb. lead; also 105 oz. gold, 19,905 oz. silver, 536,120 lb. lead, and 1,826,903 lb. zinc. Shipments were valued at $256,372, plus $29,740 in transit. Operations cost $202,971. After paying all charges, net profit was $23,349. Cash, supplies, and ore in transit are valued at $50,873, and equipment at $633,969. Current liabilities are $47,601. Leo Greenough is president.

Twin Bridges.—Results in 1917 of mines in the Tobacco Root range of Madison county were the best on record, but the coming season is expected to be better. The B. & H. mine employs 50 men. Mill is closed temporarily, but high-grade ore is being shipped. Investor's company, operating the Lake Shore mine, has a modern cyanide plant in its mill. Crystal Lake company is erecting a mill. Generally the district is busy.

NEVADA

Copper Canyon.—Copper Canyon Mining Co. is shipping 40 to 50 tons of ore daily, employing a caterpillar tractor and four horse-teams to Dilion, the nearest railroad point. Ore of good grade is being drawn from the new 113 and 188 stopes. Preparations have been made to re-open old stopes on the second vein.

Elko.—Standard Oil Shale Co. was re-organized at Salt Lake City on March 17. Samuel Newhouse is president. Capital is $1,250,000. Property consists of 4000 acres near Elko, and 1000 acres near Levan, Juab county, Utah. To distill oil from the shale a 100-ton plant is to be erected at Elko.

Fernley.—Work is again under way at the Talapoosa mine, 12 miles south-east of Fernley. L. Graefe is in charge and reports that the shaft is to be deepened. Vein has been opened 200 ft., and is from 8 to 15 ft. wide. Silver constitutes 75% of total value. About 20 tons daily of silver-gold flux ore is sent to the Mammoth smelter at Kennett, California. Property was subject to litigation in 1909, and was idle four years. Now under lease to J. F. Gaines and others of Paso Robles, California.

Goodsprings.—Zinc mines closed last fall are being re-opened on account of price of spelter being fixed by the Government.

Manhattan.—White Caps mill is treating 115 tons daily of ore from east orebody on 300-ft. level.

Manhattan Consolidated had a sudden inrush of water last week, rising 130 ft. to No. 4 level before pumps got it under control.

National.—Santa Rosa group of seven silver-gold claims has been sold by F. R. O'Leary of National and George H. Pearce, Stockton, California; to J. P. Clough, Duluth, Minnesota. The property is 4 miles north of Paradise Hill, a few miles from National.

Silver Peak.—Nivloc Mining Co. is operating the old Stimler mine 12 miles west of this place. Shaft is down 440 ft., and on 200-ft. level good ore has been opened. Harry Stimler is in charge.

Tonopah.—Development in this district last week revealed nothing of importance, although all work is entirely satisfactory.

Dividend of 7½% will be paid by Tonopah Mining Co. on April 20. This is the 51st regular quarterly distribution, and makes $14,650,000 to date.

Tonopah Divide shares rose to $2 last week on strength of 20 ft. of ore at 160 ft. and 50 ft. wide at 270 ft. depth. Ore is said to be of good grade. This mine is in the Gold Mountain district, near Tonopah, where operators are endeavoring to eliminate extralateral rights and have vertical side-lines.

Virginia City.—Union Consolidated pays an extra dividend of 5c. per share on April 1. This is the fifth since February 1.

Yerington.—Nevada-Douglas in February made a profit

of $20,000 from its mines and $10,000 from the railway. Shipments are 260 tons daily. In the Western Nevada claim a good deal of 2.7 to 5% copper ore has been opened. On 800-ft. level of Ludwig mine a new orebody assays 3 to 15%.

NEW MEXICO

Columbus.—Sierra Rica Mining Co. of Luna county has been incorporated by B. M. Reed, B. Roby, and F. D. Rody, with a capital of $1,000,000, of which $2000 is paid up.

OKLAHOMA

Production of all districts last week was 4716 tons blende and 1356 tons lead, valued at $353,560.

Commerce.—This district's output is growing, following a period of only fair production.

Hockerville.—Choctaw Chief Lead & Zinc Co. has opened ore 15 ft. thick, assaying 8 to 17% blende and lead, and is erecting a mill.

Picher.—Crystal Mining Co. of Oklahoma City is to erect a 250-ton mill at an early date. Ben B. Dancy is president.

Mint Mining Co., in Blue Mound district, has found 15% ore by drilling to depth of 175 to 270 feet.

OREGON

Gold Hill.—Millionaire gold mine, three miles east of this place, closed for a number of years, has been sold by the McKeen National Bank, of Terre Haute, Indiana, to Charles Knight and associates of that city. The new owner has arrived at Gold Hill and taken charge. He reports that much new machinery is in transit to the mine. This mine is on level ground at an elevation of 1730 ft., and is opened by two vertical shafts 400 ft. deep, with several hundred feet of levels opened both ways. There are three parallel veins, which strike east and dip 60°. All contain quartz with pyrite, with some galena and chalcopyrite. Country rock consists of dark argillate, with bands of andesitic material. Shafts are well equipped with electrically-driven machinery. Mill includes two Nissen 1500-lb. stamps, with amalgamating plates, crushers, and Standard concentrating tables, which have never operated.

UTAH

By April 1 the following companies will have paid dividends amounting to $4,468,000:

	Per share	Amount
Utah Consolidated	$0.50	$150,000
Utah Copper	2.50	4,061,250
Bingham Mines	0.50	71,500
Silver King Con	0.10	75,000
Tintic Standard	0.03	35,250
Judge M. & S.	0.12½	60,000
Daly	0.15	15,000
Total		$4,468,000

Bingham.—U. S. S. R. & M. Co.'s mines in this district produced as follows in 1917: 203,212 tons of ore, 28,063 oz. gold, 826,751 oz. silver, 17,712,924 lb. lead, and 10,175,014 lb. zinc. Gross value was $3,667,410, and cost of extraction $2,947,784, leaving $719,626 net.

Gold Hill.—Deep Creek Investment Co., F. W. Ferriss president, may erect a mill in this district to treat low-grade ore.

Garrison Monster company's lessees have opened rich gold-silver-lead ore.

Park City.—Ore and concentrate shipments last week totaled 2160 tons. A feature was the initial shipment of 240 tons of spelter by the Judge M. & S. Company.

Silver King Consolidated adit is in 5800 ft. Three shifts are advancing 16 ft. daily. Distance to company's California-Comstock property is 8000 ft. farther. This mine is said to show 40,000 tons of ore above 250 feet.

Daly Mining Co. pays 10c. per share on April 1. This is equal to $15,000 and makes $3,000,000 to date.

New Quincy Mining Company reports for 1917 that revenue totaled $17,342, including $2149 from sale of ore. Expenses were $17,306, leaving $36 on hand. Debt at end of year was $45,626. Superintendent P. P. Harrington states that 6 cars of ore was shipped. Developments appear to be favorable.

Tintic.—Centennial Eureka mine in 1917 yielded 47,175 tons of ore, 7719 oz. gold, 560,910 oz. silver, 117,170 lb. lead, and 1,648,286 lb. copper. Gross value was $1,082,192, and cost of extraction $790,921, leaving $291,271 net.

WASHINGTON

Chewelah.—Northwest Magnesite Co. is to spend $150,000 in new machinery. R. N. Bishop is in charge. This mine was closed two weeks ago, no reason being given.

United Copper Mining Co. shipped 14 cars of ore during February. Ore from 1250-ft. level averaged $115 per ton. At that point the vein is 5 ft. wide, with 6 to 18-in. rich streak, remainder assaying 7% copper and 8 oz. silver per ton. Diamond-drilling is to be started soon.

Metaline.—Spokane and Metaline men have a bond and 3-year option for $85,000 on Diamond R and Bella May properties from the Spokane Lead Co. Royalties on shipments are to apply on purchase price. Large bodies of zinc ore are said to have been recently uncovered in the Bella May, and also some splendid lead ore in the Diamond R. New company is to be known as Diamond R Mining Co. and is composed of R. H. Hutchinson, W. H. Crawford, E. S. Campbell, Oscar DeCamp, and T. S. Hutchinson.

Nighthawk.—At this place in Okanogan county, the Bender Metals Milling Co. is constructing a mill, but has no mine. The idea is to treat ore from the Cabin silver-lead mine, Rich Bar, and others in the district. J. W. Douglas is part owner.

Oroville.—A mill is to be erected at the Ivanhoe mine on Palmer lake. A. W. Boyd is superintendent, and W. B. Boucher of Edmonton, Alberta, is largely interested.

Republic.—Last Chance mine of Lone Pine-Surprise Consolidated Mining Co. has been re-opened. Additional boilers have been installed. Production is to be increased to 1000 tons per month. C. P. Robbins is in charge.

CANADA

British Columbia

Anyox.—Granby Consolidated company's copper production in February totaled 3,843,686 lb., of which 3,125,677 lb. came from the Hidden Creek mines. A year ago the total was 2,580,288 pounds.

Nanaimo.—Granby Consolidated is preparing for construction of wharves, coke-ovens, and considerable equipment at its coal mine here.

Trail.—Ore received by Consolidated Mining & Smelting Co. during second week of March amounted to 9602 tons.

Ontario

Cobalt.—First two months of 1918 have been prosperous for local companies. Despite one of the severest winters known to pioneers of northern Ontario, silver production continued uninterruptedly. With spring near, and silver prices holding firmly at around 85c., there are indications that the current year's output will surpass in value any previous yield.

At Trethewey mine, 3 Groch flotation machines have been ordered to treat 150 tons daily of tailing from the 66,000-ton dump.

Flotation plant is to be installed at Peterson Lake mine, to treat 9000 tons of tailing assaying 9 oz. silver per ton. About $62,000 is estimated to be extracted, against which must be placed cost and operation of plant, about $15,000.

Nipissing mine during February produced silver valued at $295,546. The high-grade mill treated 82 tons, and the low-grade mill 5995 tons of ore. Although a short month the yield was well up to average.

La Rose company's Violet mine shows three veins in keewatin formation at depth of 380 ft. This is regarded as of great value to the company.

Kerr Lake in February produced silver valued at $175,784, of which $122,640 was profit.

Gowganda.—Mining men of this district reecntly asked the Minister of Lands and Mines and the Deputy Minister for $200,000 to construct a road from Elk Lake to Gowganda, about 30 miles. A grant of $100,000 may be secured. Freight costs up to $1 per 100 lb.

Kirkland Lake.—Lake Shore company's new mill was started last week.

Porcupine.—Important feature of this district is the steady improvement in labor supply. Wages paid are high, and tend toward higher operating costs, but in return efficiency of employees improves.

CHILE

Chuquicamata.—Chile Copper Co. in January produced 8,358,000 lb. of copper.

Sewell.—Braden Copper Co. produced in February 4,754,000 lb., compared with 6,200,000 lb. in January.

MEXICO

Aguascalientes

Aguascalientes.—American Smelting & Refining Co.'s smelter here was closed last week, 1500 men being out of work. Cause for suspension is said to be an attempt by the State of Aguascalientes to collect ₱22,000, plus ₱13,200 Federal stamp-tax, alleged to be due the State and Nation in taxes under an article calling for a tax of 0.5% on the product of the plant. At the division office of the A. S. & R. Co. at El Paso, Texas, it was said that the attempt of the State of Aguascalientes to collect the additional tax is unconstitutional, and that the tax would be prohibitive. It was also said that the Mexican government had advised the company not to pay the State tax. Smelter had been operating nearly a year on ores principally from the Santa Francisca and El Orito mines in the Aguas and Tepezala districts, shipping the bullion produced to the East for refining. The A. & S. R. smelters at Monterrey and Matehuala are still operating. The Mexican manager, C. L. Baker, has gone to New York.

Sonora

Chinipas.—Rio Plata mine of H. W. Miller and others, 20 miles from this place in south-western part of the State, is one of the few American-owned properties that passed through the revolution without molestation. New machinery has been erected recently, and the mine is producing considerable silver ore.

Cananea.—Calumet-Sonora Mining Co., whose property is 4 miles from here, is erecting a 500-ton concentrating plant to treat ore from the Catalina mine. Ore is a sulphide, and carries silver, lead, zinc, and copper. Company is now operating a 200-ton plant to which flotation equipment is being added.

El Tigre.—North Tigre mine, adjoining El Tigre mine here, has been leased to New York people represented by F. J. Holmes of Douglas, Arizona. Underground workings amount to 5000 ft. Reserves are estimated as 30,000 tons averaging 24 oz. silver per ton. Shipping ore carries 6% copper and some lead. Mill is of 25-ton capacity and is to be enlarged.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Eugene B. Braden is at New York.

L. S. Austin is at Long Beach, California.

J. M. Callow was in New York last week.

C. R. Wilfley is here from Ouray, Colorado.

F. R. Weeks has returned to New York from Cuba.

Ben. S. Revett has returned from northern California.

A. H. Elftman, of Goldfield, Nevada, is in San Francisco.

George J. Bancroft, of Denver, was in San Francisco this week.

C. F. Tolman Jr. has gone to Arizona on professional business.

D. B. Dowling has been elected president of the Canadian Mining Institute.

E. R. Robinson has joined the 27th Engineers, and is at Camp Meade, Maryland.

C. G. Patterson of the Butters Filter Co. has left Johannesburg and gone to Chile.

N. B. Roper is general manager for the Sociedad Minera Backus y Johnston, in Peru.

T. J. Harwood is now manager of the Schumacher mine in the Porcupine district of Ontario.

H. DeWitt Smith is superintendent of mines for the United Verde Copper Co., at Jerome.

E. H. Hamilton has left Trail, B. C., and is now with the U. S. Smelting Co. at Midvale, Utah.

S. S. Fowler passed through San Francisco on his way from British Columbia to southern California.

John F. Bauchelle and **F. M. Wichman** have formed a partnership, as mining and metallurgical engineers, at Salt Lake City.

Lewis Searing has sold his interest in the Denver Engineering Works to H. W. Hardinge, of the Hardinge Conical Mill Co., New York.

Edward McSherry, of Boulder, Colorado, has been appointed foreman of the mill of the Molybdenum Products Co., at Climax, near Leadville.

Evander B. Schley succeeds his father, the late Grant B. Schley, as president of the Britannia Copper Mining Co. and other enterprises in British Columbia.

S. S. Fowler, James Anderson, and **Ivan De Lashmutt** constitute the committee selected to enquire into the fairness of the rates charged by the Trail smelter of the Consolidated Mining & Smelting Company of Canada.

H. H. Nicholson has resigned position of consulting engineer to the Plinco Copper Co., and is examining copper properties in south-western Nevada, with headquarters at Luning.

Henry R. Putnam, who recently returned from China, has been appointed a Captain in the Engineer Reserve Corps and has been assigned for duty at the General Engineer Depot, Washington, D. C.

Edward W. Clark, until recently advisory engineer to ex-Senator W. A. Clark, died at Whittier, California, on March 21. He was born in Wisconsin and went to Montana in 1880. Later he became manager of Clark's reduction works at Butte and opened up the Mayflower mine. In later years he lived at Ophir, in Utah. He was an able mining engineer and played an honorable part in Western mining enterprise.

A number of topographic draftsmen are wanted by the Department Engineer, Santa Fe Bdg., San Francisco, for work in connection with military mapping. Salaries range from $90 to $125 per month.

THE METAL MARKET



METAL PRICES

San Francisco, March 26

Aluminum-dust (100-lb. lots), cents per pound	90
Aluminum-dust (ton lots), cents per pound	80
Antimony, cents per pound	15½
Antimony (wholesale), cents per pound	13¼
Electrolytic copper, cents per pound, in carload lots	23½
Electrolytic copper, cents per pound, in small quantities	24⅝
Pig-lead, cents per pound	7½— 8⅛
Platinum, soft and hard metal, respectively, per ounce	$108— 116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	10
Zinc-dust, cents per pound	17½

ORE PRICES

San Francisco, March 26

Antimony, 45% metal, per unit	$1.10
Bismuth, per pound	$2.50
Chrome, 38% and over, f.o.b. Cal., minimum, per pound	$1.25
Magnesite, crude, per ton	$8— 10
Manganese, 40%, f.o.b. New York, per unit	$1.20
Manganese, chemical, per ton	$80—100
Tungsten, 60% WO_3, per unit	$24
Molybdenite, per lb., 85% MoS_2 (nominal)	$2.15
Pyrites, domestic, per unit of sulphur, cents	28

EASTERN METAL MARKET

(By wire from New York)

March 26.—There are no new features in copper. Lead is quiet and steady. Spelter is dull and lower. No quotations for platinum.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Mch. 20	88.25	Feb. 12	85.93
" 21	89.87	" 19	85.48
" 22	90.87	" 26	85.30
" 23	92.87	Mch. 5	85.12
" 24 Sunday		" 12	85.66
" 25	92.87	" 19	86.71
" 26	92.87	" 26	91.27

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	....	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

The sudden rise in silver on March 21 was attributed to demand from China and India. The price of 89⅞c. does not actually represent the figure paid for the metal in New York, for payment of a premium, resulting from shipments to the Orient, sent the actual market price to 93½. The difference in price represents a saving in freight rates and insurance over the Pacific as compared with costs of shipment by the trans-Atlantic route.

Three cents per ounce added to New York prices gives about the San Francisco quotation for silver.

If the bill before Congress, to authorize the Government to melt and sell over 200,000,000 silver dollars, is passed, it will release 154,700,000 oz. of metal on the market. On March 1, 1918, there were 461,304,736 pieces of silver coin in Treasury vaults.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Mch. 20	23.50	Feb. 12	23.50
" 21	23.50	" 19	23.50
" 22	23.50	" 26	23.50
" 23	23.50	Mch. 5	23.50
" 24 Sunday		" 12	23.50
" 25	23.50	" 19	23.50
" 26	23.50	" 26	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	....	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Mch. 20	7.25	Feb. 12	7.00
" 21	7.25	" 19	7.08
" 22	7.25	" 26	7.10
" 23	7.25	Mch. 5	7.33
" 24 Sunday		" 12	7.25
" 25	7.25	" 19	7.25
" 26	7.25	" 26	7.25

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	....	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

Ore at Joplin, Missouri, is easier at $85 per ton, a drop of $2.50, basis 80% lead content.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Mch. 20	7.62	Feb. 12	8.00
" 21	7.62	" 19	8.00
" 22	7.62	" 26	8.00
" 23	7.50	Mch. 5	7.91
" 24 Sunday		" 12	7.79
" 25	7.50	" 19	7.75
" 26	7.50	" 26	7.56

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	....	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Ore prices at Joplin, Missouri, are unchanged at $65 per ton, basis 60% zinc content. Second-grade product has dropped from $52.50 to $50 and $47.50. Calamine is weaker at $30 to $35 per ton, basis 40% metal content. In the Missouri-Kansas-Oklahoma region there is estimated to be 25,000 tons of concentrate on hand, sold and unsold. Production exceeds demand. Several buyers are out of the market.

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	....	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Tin imports from the Dutch East Indies may be curtailed by the taking over of Dutch ships by the Allies.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date		Week ending	
Feb. 26	115.00	Mch. 12	115.00
Mch. 5	110.00	" 19	115.00
		" 26	115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	.....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	.....
Mch.	219.00	113.75	.....	Sept.	75.00	112.00	.....
Apr.	141.60	114.50	.....	Oct.	78.20	102.00	.....
May	90.00	104.00	.....	Nov.	79.50	102.50	.....
June	74.70	85.50	.....	Dec.	80.00	117.42	.....

As an illustration of the variance between the Government 'fixed' or 'agreement purchase' prices of a number of commodities the following comparison will be found of interest. The first price column shows the quotation recognized by the Government, the second column gives the actual transaction prices in the New York markets within the past fortnight:

	Government cents	Market cents
Ammonia, aqua, 26°	8½	24
Arsenic	9	16½
Acetate of lime	4	8
Glacial acetic acid	18	38
Liquid chlorine gas	10	20
Bleaching powder	2½	2
Caustic soda	3⅞	4
Phenol	28	55 to 57
Sulphuric acid, 66°, per ton	$24	$45 to 90
Toluol, per gallon	$1.50	$5.50

The first is a manufacturer's price; the second a re-sale spot offering. The general tendency in the trade, however, is to bring the Government and the market quotations into a more reasonable relationship by the elimination of the high 'profiteering' figure, even though supplies of the commodity may be small with no assured prospect of immediate relief through surplus production above Federal requirements.—'Oil, Paint, and Drug Reporter.'

Eastern Metal Market

New York, March 20.

The entire metal market is inactive, the dullness having spread to the tin market.

Copper is without new development or feature.

Tin is at a standstill, even for future shipment, with spot metal nominal and unavailable in wholesale lots.

Lead is less active than a week ago and is easier, with quotations unchanged.

Tin continues to weaken, if anything, and is lifeless.

Antimony is quiet and unchanged.

The conference between steel-makers and the War Industries Board is being held in Washington today, and manufacturers have entered it with the knowledge that they will be asked to make reductions on some products, particularly on pig-iron. Foundry-iron makers oppose a lower price, and a compromise may be effected by reducing basic iron $1 per ton, that is, to $32, and bessemer iron, which is 10% higher, from $36.30 to $35.20. Scrap prices are also likely to be revised, since some grades are already under the Government price. No general revision of existing prices for rolled products is looked for, and steel men contend that the uncertainties of the situation, which are already affecting the demand, should be removed by making the new prices effective for at least six months. Steel output, with some companies, has made a considerable advance in the past week, the Steel Corporation plants evidently coming closer to normal capacity than most of the independent producers.

COPPER

The market is devoid of interest and practically bare of news. The representative of a large copper dealer here said yesterday to your representative that there is no scarcity of copper nor is there an over-supply. He said that there is just enough to meet present needs. While output is better and railroad conditions improved, consumption is tremendous both by the Government and by the Allies. Domestic consumers, not having Government contracts, are not receiving supplies of copper as fast as needed, otherwise deliveries are more satisfactory than formerly. It is claimed that certain consumers, who usually buy metal in jobbing lots from jobbers, are now resorting to scrap-copper, which they can purchase for less than the fixed price of 24.67½c. per lb. that applies to ingot-copper. This is easily feasible when the proper grade can be assured. There is less agitation respecting a higher price for copper. The matter has by no means been forgotten, but it is now recognized that much may happen in the next nine or ten weeks to change conditions which were admittedly bad for low-cost operation in January and February. The present price of 23.50c. per lb. for carload and larger lots is effective until June 1.

TIN

After several weeks of marked activity in dealings in tin for future shipment, the market has come to a complete standstill. The reason is not apparent. In the last 10 days a conservative estimate has placed the transactions in tin for that period as not exceeding 400 tons—and this may be liberal. It was all futures, of course, spot metal, both Banca and Straits, being unobtainable in large lots. Tin is tin now, and buyers will take anything they can get when they must have it. A 5-ton lot of Chinese tin sold at 83c. here a few days ago for spot delivery, and a parcel of 25 tons of double refund Lamb & Flagg metal brought 86c., almost as soon as offered. Cables continue to be abnormally delayed, greatly retarding dealings. Arrivals to March 18, inclusive, were 1202 tons, with 6300 tons reported afloat. The London market has not changed much in the week. Yesterday the quotation there for spot Straits was £321 10s., or £1 under last week.

LEAD

There has been very little change in the past week. The tone is decidedly easier but quotations are unchanged in the outside market at 7.25c., New York, and 7.10c., St. Louis. The American Smelting & Refining Co. continues to quote 7.25c., New York. The market is entirely a drifting one, with no features of interest. Free offerings have been a little more numerous, but this has not been a factor. Arrivals from the West are better, though some cars are still weeks behind schedule. The easier tone is due almost entirely to the better weather conditions. Buyers are much scarcer and the spot market is lower. This position can be bought as low as 7.37½c., New York, though one dealer says he has sold spot lead at 7.75c. in the last few days. The American Smelting & Refining Co. has closed its smelter at Aguascalientes, Mexico, because of taxes imposed by the Government, it is said. This is covered in The Mining Summary of this issue.

ZINC

Despite predictions some time ago that the market could not go any lower, the past two or three weeks has witnessed a gradual weakening. Since our last letter a week ago the situation has not grown better, and the market for prime Western is even weaker. The quotation for early delivery is unchanged at 7.50c., St. Louis, or 7.75c., New York, that of most of the large interests, though some are quoting 7.37½c., St. Louis, or 7.62½c., New York. Sales are not of any consequence, being limited to small lots here and there. It is market opinion that the production of prime Western must decline still further to impart any strength to the market, for it is believed by many to be impossible to get more than a new dollar for an old one now. Grade A is officially pegged at 12c. per lb., and sheet zinc at 15c. Exports in January were 13,025 tons, as compared with a monthly average in 1917 of 16,024 tons. This is a decline of about 20%.

ANTIMONY

Outside of Government purchases there is very little doing and these transactions are not made public. One dealer estimates that the Government purchases have probably been made at an average of 13c. per lb. Sales of small amounts are reported, but the market is generally quiet at 13.25c. per lb., New York, duty paid, for Chinese and Japanese grades for prompt and early delivery. Imports of antimony were nearly 70% larger in 1917 than they were in 1916.

ALUMINUM

For 50-ton lots and over of No. 1 virgin aluminum, 98 to 99% pure, the Government price of 32c. per lb. rules. In the last week differentials have been established, among which may be mentioned 32.10c. per lb. for 15-ton lots, and 32.20c. per lb. for 1-ton lots. Scrap prices have not been announced. The price of aluminum in France has been advanced from 4 francs (32.7c. per lb.) to 6.40 francs, or 50.9c. per lb., according to the French paper 'Echo des Mines.'

Company Reports

EDNA MAY GOLD MINING CO.

Property: gold mine at Westonia, Western Australia; one of the few new producers in the Commonwealth.

Operating Official: M. T. Williams, general manager.

Financial Statement: during half-year ended October 31, 1917, revenue was £62,943. Six dividends, one of 72c. and five of 48c., absorbing £27,520, were paid. Balance forward was £59,354.

Development: the 480-ft. level is being opened, and reserves to that depth are 50,393 tons, assaying $15.44 per ton. Water pumped is 40,000 gal. per hour. Development cost $2.24 per ton.

Production: in the 6 months under review, the mill treated 18,092 tons of $15.18 ore. Of the gold, 90.17% was extracted by amalgamation and 7.89% by cyanidation. To date there has been treated 140,064 tons, yielding gold worth £580,772 ($2,900,000), an average of $19.90 per ton.

Costs: for period were $5.64 per ton.

OSCEOLA CONSOLIDATED MINING CO.

Property: copper mine in Michigan, controlled by Calumet & Hecla Mining Company.

Operating Officials: F. H. Haller, superintendent; A. L. Burgan, mill superintendent; James Rowe, mine superintendent; C. D. Hohl, engineer.

Financial Statement: receipts from copper delivered in 1917 were $3,453,758. Gross profit was $1,777,625, less $105,159 for income-tax and $496,935 for excess profits tax, leaving $1,175,532 net. Balance of current assets at beginning of year was $2,677,547, and at end $2,410,190.

Dividends: in 1917 amounted to $1,346,100, making $16,602,575 to date.

Development: 6309 ft. was done during the year. No. 5 Osceola shaft is 4667 ft. deep, and No. 6, 4734 ft. That part of the Osceola mine above No. 46 level and nearest extreme south was most productive and profitable. In North Kearsarge mine, 3 storage-battery locomotives and 5-ton ore-cars were ordered for No. 4 shaft. The South Kearsarge mine made a substantial profit.

Production: past four years show the following results:

	1917	1916	1915	1914
Ore hoisted, tons..	1,245,757	1,295,836	1,380,255	1,136,118
Sorted out, per cent	0.638	0.861	1.389	2.436
Ore milled, tons...	1,237,805	1,284,681	1,361,089	1,108,447
Copper, pounds ...	16,084,958	19,586,501	19,731,472	14,970,737
Average per ton, lb.	13.0	15.2	14.5	13.5
Cost per ton.....	$1.63	$1.36	$1.18	$1.29

HOMESTAKE MINING CO.

Property: one of the largest gold mines in the world, fully equipped with hydro-electric installations, mining plant, 1020 stamps, sand and slime cyanidation plants, foundry, etc., all at or near Lead, South Dakota.

Operating Officials: superintendent, B. C. Yates; metallurgist, W. J. Sharwood; consulting metallurgists, C. W. Merrill and A. J. Clark.

Financial Statement: for year 1917 receipts from bullion were $6,619,574, from wolframite, $226,535, and from sundries, $30,865, a total of $6,876,974. Disbursements totaled $4,868,145. This left an operating profit of $2,008,829. Balance forward from 1916 was $949,934, and that carried forward to 1918 is $1,189,403. General supplies increased from $383,635 to $553,240. Liberty Bonds amount to $210,000.

Dividends: paid last year amounted to $1,959,048, making over $40,000,000 to date.

Development: total new openings covered 19,320 ft. Estimates of broken ore show 1,919,177 tons. Blocked out there is ore for many years extraction. A new ventilating system for lower levels is well under way. Electrically-driven fans form part of equipment. The new Nordberg hoist and skips can easily supply the Homestake mills. At 800, 1100, and 1550-ft. levels are loading-pockets. The wolfram deposits should be able to keep the small mill supplied for another year. Every department is in first-class condition, according to Richard Blackstone, previous superintendent, who resigned late in 1917 after 39 years service.

Production: mills and cyanide plants treated 1,677,623 tons of ore averaging $3.9458 per ton, yielding gold valued at $6,619,574.

Costs: although dressing of wolframite is included, costs may be summarized as under:

Department	Per ton	Department	Per ton
Mining	$1.35	Cyaniding	0.20
Development	0.05	New electric plants.....	0.26
Shaft (7) operation.....	0.28	Taxes	0.18
Tramway	0.04	Sundries	0.23
Milling (6)	0.29		
Regrinding	0.02	Total	$2.90

Sundry items include freight on bullion, Ellison hoist, steam and coal line, property purchase, aid fund, beneficies, hospital, and recreation hall operation, office, legal, etc.

YUKON GOLD CO.

Properties: dredging ground on the American, Butte, Feather, Trinity, and Yuba rivers in California; dredging ground on Prichard creek, Idaho; dredging ground at Dawson, Yukon; and at Iditarod and Ruby, Alaska; hydraulic property at Dawson, with 70-mile ditch, powerplant, etc.; and gold mine at Jarbidge, Nevada.

Operating Officials: C. H. Munro, acting general manager; E. E. McCarthy, manager at Dawson; H. C. Perring, manager of Pacific operations; C. E. Moran, secretary.

Financial Statement: 1917 income from gold, etc., totaled $3,965,231. Operations cost $2,226,992, plus $365,094 for royalties, interest, and general expense. Net income was therefore $1,373,146.

Dividends: $1,050,000 was distributed during the year.

Development: 7½-cu. ft. dredge on American river finished its work, and was re-erected on North Fork, to resume early in May 1918. Boat on Trinity started on December 9. Murray 7½-cu. ft. dredge in Idaho started on December 4 in a new field, but is quite satisfactory. Ground proved contains 10,600,000 cu. yd., averaging 14.4c. per yard. Seven boats worked at Dawson. This, the eleventh season, lasted 151 days. As two completed their work, only five will operate in 1918. Dredge at Ruby worked 153 days, completed its ground, and has been dismantled. Iditarod dredge worked 192 days. Season for hydraulicking was generally favorable, but was not ideal for thawing gravel banks. At Jarbidge, 100-ton mill at Elko mine, also 75-mile transmission-line, were completed and are ready for operation in March 1918. Starlight mine nearby was acquired. It contains 9800 tons of ore worth $212,000 gross value.

Production:

Operations by	Cubic yards	Per yard	Cost	Profit
Californian dredges	6,161,941	$0.0840	$0.0371	$289,155
Dawson dredges	4,583,326	0.3787	0.2581	553,099
Dawson hydraulics	2,143,444	0.2147	0.1180	207,709
Iditarod dredge	871,045	0.9150	0.4810	377,834
Ruby dredge	264,132	1.1740	0.5320	169,415
Total	14,025,888			$1,597,212

Latest estimates indicate that earnings from present properties will be insufficient to meet notes aggregating $5,000,000, held by Yukon-Alaska Trust, also to continue present dividends; therefore disbursements are to be reduced for the time being.

Mining Decisions

Coal Lease—Subjacent Support

In a suit by a lessor of coal lands against his lessee for damages resulting from the subsidence and caving in of the surface caused by lessee's mining operations, held, that the lessor did not waive his right to subjacent support by executing a coal-mining lease which did not expressly contain such a waiver.

Walsh v. Kansas Fuel Co. (Kansas), 169 Pacific, 219. December 8, 1917.

Oil and Gas Lease—Royalties

Under an oil and gas lease entitling the lessor to certain royalties from oil-wells brought-in and certain further royalties from gas-wells brought-in, held, that where the lessee brought-in a well which produced both oil and gas in marketable quantities and under marketable conditions, he must pay both royalties on the one well.

Prichard v. Freeland Oil Co. (West Virginia), 93 South-Eastern, 871.

Mining Claim—Character of Ground—Adjudications

A plaintiff seeking an injunction to restrain trespass, based his title on an alleged mining location, made according to law, but subsequently included within the boundaries of a National Forest Reserve. Defendant interposed a plea of former adjudication by the Secretary of the Interior of the non-mineral character of the land given at a former period in denying plaintiff's application for a mineral patent to his claim, and claimed that plaintiff's location was therefore void because of lack of discovery. Held, judgment for defendant. Decisions of the Land Department have the effect of final adjudications as to matters properly within its jurisdiction, such as determination of the character of the land in patent proceedings, and will be so recognized by the Courts. A later judgment establishing plaintiff's title as against other parties will not avail plaintiff in this case, because the Government was not a party to that suit.

Cameron v. Bass (Arizona), 168 Pacific, 645. November 8, 1917.

Mining Claims—Location Requirements—Seniority

Failure of mining locators to comply with the State statutes relating to the recordation of location notices within 20 days after the discovery, where the State law does not expressly provide for a forfeiture upon such failure, does not invalidate the location. The defects are cured by subsequent issuance of patent on the theory that it amounts to an adjudication of sufficient compliance with location formalities. They are also cured by subsequent amendments to the Montana codes, validating prior locations which conform with the amended law. Priority of a senior location is not lost by failure to adverse the application for patent of a junior location where no conflict on the surface is shown by the survey for patent or notice of application. A quit-claim deed covering an undivided interest in the Black Rock claim is not a conveyance by metes and bounds and does not estop the grantor from asserting subsequent claims to extralateral segments of veins apexing on other claims, where the segments underlie the Black Rock surface. Findings of the trial court as to continuity of veins and ownership of points of intersection held supported by sufficient evidence.

Butte & Superior Copper Co. (now B. & S. Mining Co.) v. Clark-Montana Realty Co. (Montana), Decision U. S. Circuit Court of Appeals, February 18, 1918. (Not yet reported).

Book Review

TREATISE ON APPLIED ANALYTICAL CHEMISTRY. By Vittorio Villavecchia and others. Translated from Italian by T. H. Pope. Vol. I. Pp. 475, ill., index. P. Blakiston's Son & Co., Philadelphia, 1918. For sale by MINING AND SCIENTIFIC PRESS. Price, $6.

Customs departments in most countries maintain laboratories in which products imported and exported are tested for valuation and standard purposes. The variety of analyses made covers a wide range, as will be seen by studying this work containing methods and standards for analysis of the principal industrial and food products. The author is director of chemical laboratories of the Italian Customs, and arranged the methods in collaboration with nine other chemists. Adulterations and impurities are found in most finished materials, and their determination constitutes a branch of chemistry worthy of cultivation by commercial, hygienic, and technical chemists, also by government inspectors. Volume I, the work under review deals with analyses of potable waters, acids, and chemical compounds, fertilizers, cement materials, metals and alloys, fuels, mineral oils, and fatty substances. Mine and smelter metallurgists will find much of value in this book. We like the concise arrangement of methods, and while it cannot be classed as elementary, yet the contents should be followed easily by students. Probably the translator is responsible for much of this desired brevity. As a practical work we commend it to chemists.

The Annual Chemical Directory of the United States for 1918 is announced by the Williams & Wilkins Co. of Baltimore. It gives names and addresses of all manufacturers of acids, alkalies, colors, dyes, drugs, explosives, synthetic products, chemical and metallurgical apparatus, machinery and supplies, professional firms, laboratories, Federal and State officials having charge of such industries, societies, and technical journals. The price is $5.

LOANS AND TAXES

The issue of $500,000,000 of United States Treasury certificates, subscription to which closed March 5, was over-subscribed, the subscription in every district, except one, exceeding the quota assigned it. The banks of the country in the past two Liberty Loan campaigns, and in the purchase of Treasury certificates issued before the loans, responded to the demands of the country with inspiring loyalty and liberality. The faith they show in the Government finances and the patriotic response they give to the calls of the Treasury are certain indications that their cooperation and assistance will help to insure the success of the Third Liberty Loan. Subscriptions for this loan open on April 6. In our New York letter of this issue the financial situation is discussed.

In comparison with the tax levied on incomes in England, American taxes are moderate. In England the tax on incomes of $1000 is 4½%, in America nothing. In England the tax on incomes of $1500 is 6¾%; in America nothing for married men or heads of families, and 2% on $500 for an unmarried man. In England the tax on an income of $2000 is 7⅞%; in America nothing for a married man or head of a family, and 2% on $1000 for unmarried men. The British income-tax rate also increases more rapidly with the growth of the income than ours, a $3000 income being taxed 14%, $5000 16%, $10,000 20%, and $15,000 25%, while our corresponding taxes for married men are respectively two-thirds of 1%, 1½%, 3½%, and 5%, and only slightly more for the unmarried, due to the smaller amount exempted, the rate being the same.



INFORMATION FURNISHED BY MANUFACTURERS

NEEDS OF THE AVIATION SERVICE

The Signal Corps announces that 10,000 machinists, mechanics, chauffeurs, and other skilled workers are needed at once by the Aviation Section. The present call for these men is to fill an immediate need, and may be regarded as the precursor of others as the service is being built up. Even then the actual strength of the service today is over one hundred times what is was on April 1, 1917. Dependence of the Air Service on most highly-skilled men is being emphasized more emphatically with every week of development. Where, in the first rush there was little experience to indicate this fact, it has since developed that practically 98 men out of every 100 in the service must be skilled in some branch. Airplane work has been wholly new and unfamiliar to American mechanics, who have been taken from other trades and converted hastily into workers on the most delicate jobs. It has been necessary for both officers and men to learn largely by experience. At the same time, a degree of care and attention, not usually associated with American quantity production and methods, has been required, as great watchfulness is essential to prevent any plane leaving the ground in imperfect condition. The Secretary of War, N. D. Baker, recently summed up the situation as follows: "The great problem now remaining is to secure the thousands of skilled mechanics, engine-men, motor repair-men, wood and metal-workers needed to keep the planes always in perfect condition. This great engineering and mechanical force at the airdromes, flying fields, and repair depots, both here and behind the lines in France, is a vital industrial link in the chain of air supremacy. Without them the planes turned out would be useless and the flyers helpless." Men registered in the draft may be inducted into this service by applying to their Local Draft Board. Men not registered may enlist at any Recruiting Office. Further information may be had by applying to the Air Division, Personal Department, Washington, D. C. In either case they will be sent to San Antonia, Texas, for segregation by trades, followed by a brief course of instruction at the flying fields or at various factories and organized into squadrons mostly for service overseas.

The present call is especially for:

Machinists
Auto mechanics
Engine repairmen
Gunsmiths
Chauffeurs
Carpenters
Blacksmiths
Tin-smiths
Cabinet-makers
Electricians
Copper-smiths
Sheet-metal workers
Propeller makers
Wireless operators and constructors
Tailors
Tent-makers
Sail-makers
Truck-masters
Vulcanizers
Welders

Makers, repairers, and installers of:

Magnetos
Ignition systems
Cameras
Watch and clocks
Instruments
Typewriters

THE ISBELL CONCENTRATOR

"Efficient as a gold pan" is the statement of the Isbell Concentrator Co. of Los Angeles for its concentrating table. This machine has a reciprocating motion, but there is no cross-wash water—practically, there is no wash-water at all. Capacities of former tables of this type have been restricted by the transverse action of this water, which is nearly at right angles with the longitudinal motion of the table and movement of ore-pulp. If the general movement of concentrate, gangue, and wash-water coincide with the progressive motion of the table, all of these forces acting in one direction combine to give great capacity and saving, as in the Isbell. Concentrate is not discharged off the ends, sides, or corners of the Isbell, and tailing discharges at one end only. Action of this table is considered to be more similar to a jig than to the ordinary cross-wash water table. This is because the bed of pulp is deep. Motion of the deck produces a stratifying action, depositing the mineral in a layer at the bottom. Concentrate is cut-out or drawn-off from the bottom layer as soon as it is formed by the means of six cut-outs, or traps, to each section. The top layer is entirely gangue, no mineral being visible. Concentrate is discharged through a device somewhat like that used for the same purpose on a jig, and there is absolutely no cross-wash water to disturb the fine and slime particles. This table will concentrate unclassified feed; also coarse, fine, and slime-pulp at the same time. Capacity is from 50 to 100 tons per 24 hours, equal to that of two to four cross-wash water tables on similar feed. On account of no wash-water the table is efficient on slime-pulp. Changes in position of cut-outs and additional width of deck increase capacity to 200 tons. The concentrate cut-out has been designed after years of experimenting, and is the secret of the Isbell's success.

The Walter A. Zelnicker Supply Co. has recently secured the services of G. W. Bichlmeir, who prior to his association with the Zelnicker company was connected with the supply departments of the Missouri Pacific and Kansas City Southern Railway companies, as well as having been secretary-treasurer of the W. L. Sullivan Machinery Co. Mr. Bichlmeir is in the Zelnicker machinery department.

Bulletin U, of the Overstrom Manufacturing Co., San Francisco, gives brief notes on its 'Universal' concentrating table. A feature of this machine is the simplicity of the driving mechanism, which consists of a weighted loose pulley, this imparting a horizontal reciprocating motion to the deck to which it is attached.

As a matter of general interest, this journal each week mentions as far as possible in its news columns mining machinery contemplated, to be ordered, or being installed. We also send regularly to advertisers a circular giving new construction. Mine operators about to buy equipment would do well to advise us, as we could then place them in communication with manufacturers.

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Hydraulic Gravel Elevators built also to meet unusual conditions.
Derricks—the kind experienced operators insist on having.
Pipe Lines and Fittings—just what is practical in this special work, and other accessories and advice calculated to bring results.

Joshua Hendy Iron Works, San Francisco, Cal.



This illustration from photograph taken at property of the Logan mine of the Waldo Corporation, at Waldo, Ore., where Hendy machinery is used exclusively.

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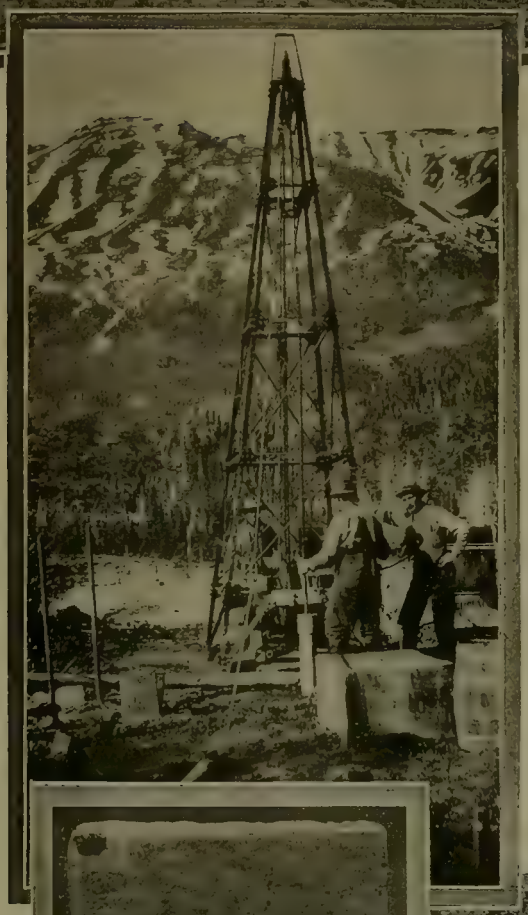
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SIR DOUGLAS HAIG responded simply and sincerely to the President's message of goodwill and sympathy. "One and all," he said, "believe in the justice of our cause and are determined to fight without counting the cost until the freedom of mankind is safe." Is not that the belief of us all and shall we not do our utmost to achieve the purpose for which our soldiers are fighting so unflinchingly?

TODAY is the first anniversary of our declaration of war against the enemy of civilization. Much has been left undone and much has been inadequately done for the waging of war, yet the accomplishment of the last twelve months by a peace-loving democratic, and therefore wholly unprepared, people has been magnificent. Most of all do we rejoice that our own soldiers are at the front during the great battle now in progress. They are the advance guard of an army that, please God, shall teach the Prussian to beware of free men when they are roused to fight for safety and self-respect.

OUR friend Mr. W. J. Sharwood, metallurgist to the Homestake Mining Company, contributes sundry interesting notes on the loss of quicksilver in mills treating gold ores. The study of the subject should lead to economy and efficiency.

IN this issue we publish another useful technical study by Mr. Walter S. Weeks, Associate Professor of Mining in the University of California. The testing of air-compressors is an important matter and it is one not generally understood by the managers of mines. We feel sure that the chart for the nozzle-discharge, more particularly, will be of immediate practical service.

THE article on the methods of recovering quicksilver from its ores, published in another part of this issue, will awaken keen interest in the bulletin on that subject, prepared by Mr. W. W. Bradley and soon to be published by the California State Mining Bureau. Mr. Bradley has confirmed the observations of other experimenters upon the feasibility of leaching low-grade cinnabar ore with sodium-sulphide solution. Good recovery is obtainable by this method from ores containing no more than 0.3% metallic mercury. At present prices this would appear to offer attractive opportunities. The obstacle lies chiefly in the cost of fine grinding, but the process yields recoveries in excess of 80%, so that the margin at the present time is ample.

CONDITIONS created by the War have indicated the need for a new executive department, representing the mining industry, in the Federal administration. We note that the leaders of the American Mining Congress are ventilating the subject and it is fitting that they should do so, for to the Mining Congress we owe the establishment of the U. S. Bureau of Mines. The lack of a Cabinet officer at the head of a Department of Mines has contributed to the confusion and ineptitude that have marked the well-intentioned efforts to mobilize our mineral resources for warfare. That the coal industry should have been placed in the hands of a college president and the buying of metals in the hands of a speculative broker are two of the consequences of official indirection. We shall be glad to support the Mining Congress in its campaign for the creation of an executive officer at Washington to represent the other of the two great productive industries of our country.

AFTER due deliberation between representatives of Mexico and our ambassador, Mr. Henry P. Fletcher, a reciprocity treaty was drafted in February, having in view the more advantageous co-operation of the two governments concerned. It did not give to Mexico all the privileges while saddling us with all the obligations, since the object of reciprocity is mutual advantage. It was to be assumed that the Mexican diplomatic agents would not exceed their authority when they occupied the time of our representatives in these negotiations, but Carranza has declined to ratify the treaty. It is time that a firm attitude were taken by the authorities at Washington to terminate the diplomatic trifling that has nullified all our efforts at kindly neighborliness ever since Carranza came into power. The acts of his government continue persistently antagonistic, serving to strengthen the conviction that they are inspired by hostile advisers. The new regulations affecting the oil-producers are onerous in the extreme, the American Smelting & Refining Company has been compelled to close its smelter at Aguascalientes because of oppressive taxation, and a German raider was

outfitted the other day at a Mexican port, which would have been utterly impossible if the local authorities had exercised proper vigilance. The last term of diplomacy is mandatory, and it is time that we protect ourselves against the machinations of the Teuton in Mexico by using plain language that admits of no misunderstanding.

DECISION of the Court of Appeals in the flotation suit of Minerals Separation v. Butte & Superior is expected in May. It is impossible to predict the result, because, among other reasons, the judges sitting in this case are not those that sat in the Hyde case. The decision apparently must turn on the question of the part played by the mineral oil added in excess of the so-called critical proportion of vegetal oil, namely, is the mineral oil inert and useless or does it contribute to the metallurgic result? Again, did the Supreme Court's decision in the Hyde case, confining the patent to the 'critical' proportion of oil, mean that the use of more than 0.5% of oil did not infringe, this 0.5% being taken as answering the Court's limitation to "the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions' 'amounting to a fraction of 1% on the ore'." Should the Appellate Court reverse the District Court it is likely that an appeal to the Supreme Court will be granted; should it sustain the District Court, an appeal may be refused. That would mean that the opponents of Minerals Separation would have to start a new litigation, and, it is to be hoped, abandon the defensive.

NEED of ships for direct service to Europe and need of imported minerals are constantly being balanced against each other by the committeemen at Washington. Recently the shipment of manganese ore to this country was restricted, and the importation of pyrite also is coming under the ban. The latest mineral to receive consideration has been chrome. A meeting was held at Washington between the Raw Materials division of the War Industries Board, represented by Mr. Pope Yeatman, the Shipping Board with Mr. J. E. Spurr as spokesman, and a large number of manufacturers and consumers of chrome ore. Mr. Samuel H. Dolbear was summoned from San Francisco to attend the conference. The two chief objects are to stimulate production, and to decrease consumption. The ability of the conference to plan effective measures seems to have been limited by the action of the War Industries Board undertaken without advice from those summoned to consider the question, and even antedating their meeting, whereby a single manufacturer was authorized to act as preferred purchasing agent with the privilege of increasing the price, which was deliberately raised from about 85 cents to a minimum of $1.25 per unit. The price was not fixed, and as a result quotations in the open market almost immediately advanced to $2, with a steady upward tendency. The effect is to encourage hoarding and profiteering. This is another example of the undemocratic procedure of the persons that control our war industry. It is time that President Wilson made his great influence felt in suppressing the evil of favoritism that destroys the confidence of the great mass of the plain people.

THE Tennessee Copper & Chemical Company has at last reached an agreement with the International Agricultural Corporation for a revision of the old contract under which it disposed of its by-product, sulphuric acid. It will be recalled that shortly after the Tennessee Copper company had completed its sulphuric-acid plant as a means of escape from the devil of agricultural protest against smelter-fume, it fell into the deep sea of a glutted market. So depressed was the sulphuric-acid business at the time that the Tennessee concern, to extend the simile, in order to save itself from drowning, was willing to climb upon the perilous raft of a contract that pledged its entire output of acid for a long term of years at the low price of $4.81 per ton. When the demand for war munitions commenced in 1915, concurrently with a general elevation in prices of labor and commodities, whatever advantage the contract might have possessed previously, quite disappeared. The quotations on acid meanwhile were advancing to unheard of levels. So urgent did the demand become toward the end of 1915 that Eastern firms even bought acid in San Francisco at about $100 per ton and shipped it to Atlantic seaboard points. The International Agricultural Corporation, apart from utilizing acid in its fertilizer business, acted as a broker, re-selling the acid at enormous prices, and having no further outlay than that involved in negotiating sales and transmitting billing instructions to the Tennessee Copper company. The logical escape from the difficulty appeared to be through an increase in the production. Thus the copper company could take advantage of the favorable market, at least for any surplus over the output of the old works. Having made plans for an extension of plant, a message was sent to the International Agricultural Corporation announcing the intention to enlarge the works, but expressing the conviction that no larger deliveries could be anticipated under the contract. The ink was hardly dry on the telegram before an official of the Agricultural Corporation demanded the entire present and future production of sulphuric acid made by the Tennessee company within the contract limits. It was a case of claiming the pound of flesh that drew the condemnation of all men upon the Merchant of Venice and that draws it still upon his imitators. It is pleasing to note, however, that the International Agricultural Corporation has been unwilling to play Shylock to the bitter end, and has made some concessions to the principle of equity. A small advance over the old rate is now agreed upon, and increased prices are allowed for the product in excess of 225,000 tons per annum. It is unofficially stated, but on good authority, that $10 per ton will be paid for the output between 225,000 and 300,000 tons. As a result of the settlement of this dispute, the copper company will expend about $1,000,000 on the enlargement of its plant.

Americanization

In this issue we publish an article that touches upon economic conditions in Arizona and refers incidentally to the heterogeneous character of the elements constituting the labor supply of the copper mines. It has seemed to the author of the article, as to other thoughtful observers, that the existence of a large foreign population in the body politic of the United States is a peril to this democracy. It is high time for every good citizen, notably the members of the mining profession, to realize that the making of a nation out of this industrial population depends upon the assimilation of many unlike elements of alien origin. Until the process of assimilation is reasonably complete the United States, as a nation, will be subject to chronic attacks of political dyspepsia. The census of 1910 showed that 37% of our people were born in Europe or born of European parents, and if to these we add those of negro blood, we see that half of the population was, and is, 'foreign' in the true meaning of that word. We have been told that this is a great melting-pot for the political reduction of unlike elements, but is it not more nearly a mixing-pot in which fusion is lacking? Fusion results from heat, and the rapidity of the process depends largely upon the presence of a minimum of refractory matter. Do we exclude such refractory human material? On the contrary, is not the lid of the crucible kept lifted so that anarchistic Russian-German Jews like Leon Trotzky, alias Braunstein, can come and go as they please? Do not the Emma Goldmans and Max Berkmanns of Europe find a free entrance? Was not Maxim Gorky petted and Rabindranath Tagore lionized? Such material would retard fusion even at a generous heat of nationalization; but the temperature is kept low, because those in authority recognize the existence of elements so highly combustible that careful treatment is required to safeguard political equilibrium. When the European war started we were told to be neutral, that is, to remain cold to the great conflict on the other side. The foreign elements were asked not to take sides for fear of domestic dissension. The temperature was kept so low that the fusion of these European fragments of nationality became impossible; on the contrary, some of those that had undergone preliminary agglomeration tended to resume their separateness. That did not last long, thank heaven; the United States arrayed herself on the side of human liberty, and the temperature in the mixing-pot rose rapidly, so rapidly that a new process of fusion began, with the promise of melting most of the refractory elements and producing good clean metal that would alloy readily with the best of the products produced by the furnaces of the Civil War and the Revolution. The War is fated to be a great Americanizer, and we thank the Kaiser for that at least! But much more must be done if the process of Americanization is to be expedited. It is surprising to hear of men being drafted into the Army that cannot speak English; they, however, will learn the language quickly enough among their new comrades, and much more than the language. Any man, whatever his origin, that fights for the United States will return from the War an American indeed. What can we do for the millions that will not obtain the benefit of such an intensive education? In the first place, any engineer that has lived abroad can testify that to understand the people of the country in which one lives, to sympathize with them intelligently and to become a part of them, it is necessary to know their language and to read their daily papers. Difference of language is the first and most obvious barrier to acquaintance and mutual understanding. The alien that does not speak the language of this country cannot understand its political ideals nor can our people obtain the benefit of the knowledge, ideas, or inspiration that he may bring as the expression of the culture from which he originated. The herding of foreigners in separate settlements and the maintenance of their national prejudices by means of newspapers printed in their own languages are among the factors making for social isolation. There should be some means of facilitating the acquisition of English by foreigners, and, it must be confessed, it would be well if more of our people would take the trouble to learn at least one foreign language thoroughly. A simple way of accomplishing both purposes would be to pass a law compelling all foreign-language papers to print an English translation in parallel column. This would serve in the first place as a tax on the foreign-language paper, which is so powerful a deterrent to Americanization, and, in the second place, it would promote the learning of English by the immigrant and his children. Next, we need a conscious and organized effort to hasten the process of assimilation. The Fourth of July last year was observed in many localities as a day for Americanization. It is an excellent idea and honors the event it celebrates, as compared with the chemical and verbal pyrotechnics heretofore flourished by small and big boys on this national holiday. We understand that Mr. George Creel's publicity bureau at Washington includes a department for reaching the foreign-born, "to stimulate their interest in American affairs, to make them realize the motives that led the United States to enter the War, and to enlist their enthusiastic co-operation." If Mr. Creel does that we shall forgive him some of his blunders; he will have done something worth while. The fact must be recognized that not only are many of these foreigners ignorant of American ideas but the more intelligent among them have ideas antagonistic to the orderly state of living upon which this republican democracy of ours is predicated. To teach them our language, to make friends with them, is not only a fraternal act, it is one of self-preservation, the conversion of an anti-social enemy into a sociable citizen. That is why we like the idea of that Y. M. C. A. building at Miami. Our mining companies depend for their supply of labor largely upon the foreign-born, and if those in authority, whether directors or managers, realize not only their own interest but also their duties as good

Americans they will do as much as they can to promote the rapid assimilation of these undigested chunks of alien race and foreign nationality. The mining engineer can help by showing a sympathetic interest in the operation; he could help greatly by learning the language of some of these foreigners—for example, Finnish in Michigan, Spanish in Arizona—so as to understand and be understood, thereby inciting the foreigner in turn to acquire the language of this country, and thus to become comfortable in it, not as a mere alien laborer, eager to make a little money and return to his native land, but as a willing resident, with the makings of a good citizen. This democracy cannot live healthily so long as it contains a large proportion of individuals ignorant of its traditions and unresponsive to its ideals. The American is not indigenous to this soil. This poeple is peculiar in being wholly of immigrant origin. Americanization is synonymous with nation-making. The fusion of the unlike elements is essential to the production of the true metal—that metal which found its best expression in Abraham Lincoln.

The Finance of War

There is an economics of war as well as of peace, and while one differs from the other materially, it must be noted that both war and peace are phases of international commerce. War is the rude disentangler of the Gordian knot of economic error, severing by a blow of the sword the hopeless maze produced through unscientific competition. Not many months ago, thousands of good and honorable men, bankers, captains of industry, professors of economics and history, doctors of divinity, philanthropists, were telling us solemnly that war was an anachronism, an impossibility. Those words echo now like a mockery, for we know that they not only sprung from the delusions of our warm-hearted peace-loving people, but that they formed a part of the propaganda instigated by Germany to lull us to sleep while she made ready to attack us unawares. These same people offered us their wise assurance that war could no longer be undertaken because, to seek no other reasons, the bankers would not finance it. Now it so happens that finance has developed into such a gigantic, tangled, mysterious, tropical growth that the plain man is no more able to contradict the expert financier than he is the returned traveler who brings marvellous tales of the wilderness of Borneo or the river of Doubt. Accordingly it was written down on the tablets that the banker would not permit war.

That theory has now proved to be not the torch of progress in the hand of Liberty, but a will-o-the-wisp in the financial swamp. We have seen the nations command their bankers, and receive loyal obedience; we have witnessed the demand upon the citizens for service and the fruits of service, to provide means for the struggle, and it has been given. Nevertheless the alien enemy in our midst manages now and then to play on the old discredited chord, telling us that Germany must soon collapse because she has exhausted her resources for financing the War. Always some internal difficulty is announced as a reason for expecting a sudden change in the attitude of the Prussian militarists. Always do their supporters find willing pens to promulgate the subtle poison of a Germany on the eve of a cataclysm that will bring her humbled and repentant as a suppliant for a democratic peace. This is part of the psychologic program of our antagonists to relax our nerves and muscles so as to impair our efforts to subdue the Huns in the one and only possible way—by force of arms. We are even told that there is a limit to our own ability to finance war.

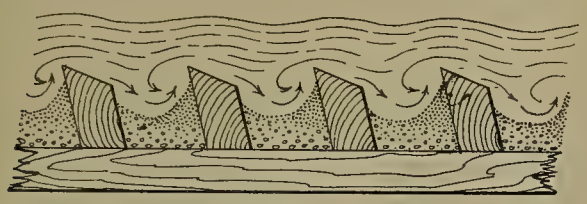
Let us strip away the encumbering details of the financial system and get down to the elemental facts. There is a final authority, even in a republic. That authority is the will of the people expressed by Congress. That is the supreme government, the sovereign power. It is created to guard and help the people collectively and individually. It has rights in and above all that you call yours and all that you produce; it also has rights in and over you as a person, a fact that every drafted soldier keenly and fully understands. The thing that sustains this war is not the dollars you pay as taxes, nor the dollars you invest in bonds; it is the output of farm and mine, and personal service in manufacturing and transportation. The dollars are only tokens of service performed but still remaining unpaid in the real materials that constitute wealth. You have not been paid when you receive dollars; it is when you have received wheat and milk and clothing and automobiles that society pays you for the services you have rendered. Your payment in money is credit, a promise to deliver something useful because you first have delivered something useful to your fellows. When you buy bonds you are diverting to your Government stored-up potentialities for commanding an exchange of others' services for past services of your own. It is a gracious and grateful response to the needs of your fellow nationals in an hour of danger; but if you do not respond in that manner, then the Government in its sovereign right as the collective voice and agent of the people will order delivery of the material fruits of the earth and of your service in producing them, in order to carry out its obligation to protect you and your fellows. That rude imperious method, however, will not be necessitated with liberty-loving Americans. It will now be evident that the sinews of war are not the money represented by the bonds, but rather are they the fields of wheat and corn and cotton, the mines of lead and copper, of manganese and tungsten, and the skilled hands and trained intellects of the American people everywhere. These will not soon be exhausted, and with these the War can proceed to final victory. At bottom, the financing of the War reduces to those simple terms, and the Kaiser's agents cannot obscure so plain an issue. It is food, metals, and service that gives us the strength to resist subjection to the will of the Hun. Meanwhile, we must pledge those needful things for the future, by drawing on our stored-up credit to purchase bonds, thus in turn pledging the coming generations as their sponsors in baptism into the freedom of a worldwide democracy.



Riffles

The Editor:

Sir—In your issue of February 16 I note a sketch of a riffle recommended by J. W. Dunham. In my opinion, Fig. 2 would work better if reversed. After a number of experiments I found the riffle shown in the accompanying cut to be most satisfactory. The riffling or 'boiling' action of the water is promoted by using a riffle with chamfered top and inclined down-stream. With this form I get nearly all the placer gold in the first six feet, and perhaps two-thirds or even three-quarters of this is caught in the first two feet with careful feeding from the ore-bin into a shaker and dump box just above the riffles.



The portion of the water which is retarded by the riffles rises over the chamfered back, and, meeting the swifter down-coming stream above, it is deflected over the sharpened edge. This action can be readily seen with clear water, the particles of sand being picked up and carried over while the gold, undisturbed, accumulates under the projecting inclined face of the riffle. As to the grade, the practice in Manhattan has settled down to 1 in. per foot, but I find that 1¼ in. per foot gives better results. This, however, must be regulated by local conditions. A sandy gravel will not require as much fall as one containing much flaky material, such as slate from the bedrock. A great deal of the Manhattan gold is found in the crevices of the bedrock, so that it pays at times to take up as much as six inches of it and sluice all together. For this reason a medium grade must be selected. Water being scarce in this camp it is pumped from the workings by a two-inch centrifugal pump in the tailing-pond, and is used over and over in the sluices. The coarse gravel is screened off with a shaker having perforations about one inch in diameter. The washed barren waste goes directly into a car from the shaker, and is dumped.

Manhattan, Nevada, February 17. L. F. Clar.

The Editor:

Sir—It seems that Mr. J. W. Dunham has hit upon a general-purpose idea for the poor man or the one of close figuring when he found that riffles with a decided undercut or overhang at the upper edge are better than the square-cornered ones.

I had never heard of the overhang riffle being used in sluicing, but have known of its being claimed to save an added 50% of gold in dry washing of dry dirt. It is said to save the flour gold where the square-cornered riffles pass nearly all of it over. Al Stevens did a lot of experimental work at dry washing at Rawhide four or five years ago and claims that the construction of the riffling is just about half the problem and can often give fully double the returns with other conditions equal. He has described his final arrangement as having had several duplicate riffle-frames all fitting snugly and quickly interchangeable so as to create in changing them no more than a pause in the machine's work after the operation was once started. There was always the chance to do repairs at night after that. He showed me a riffle-frame that was undercut at the upper edges of the riffles about twice as much as your illustration.

I am not now positive but think that the old concentrator plant at Butte had all its riffles, which were wooden, undercut on the upper edges or sides.

Geo. E. McClelland.

Sonora, California, February 21.

The Reduction of Hematite

The Editor:

Sir—A communication in your issue of February 2, from Mr. Thomas French, on the reduction of hematite to metallic iron by oil, recalls to my mind a similar occurrence.

Some years ago I received a package of mineral chippings and nuggets with a statement of their source and a request for an analysis and an explanation of the phenomenon. The letter accompanying stated that the writer was engaged in drilling for coal. The drill-tool had been passing through very hard limestone when it encountered a much more resistant substance that delayed operations for several days. In penetrating or otherwise disposing of the hard material the sludge brought up the chips and nuggets and afterward entered shale and softer limestone.

Examination showed that the surface formation was Permian, and doubtless the metal came from the line of contact with the Upper Carboniferous shale. The chips and nuggets proved to be remarkably pure iron, over

99%, so soft and ductile that it could be rolled into paper-like sheets. Larger pieces, weighing several grammes, when polished and etched gave no evidence of Widmannstätian figures.

I accounted for the iron on the theory that it had been reduced from bog-iron or limonite by the organic matter in the underlying shale. In passing I would suggest that whenever metallic iron is found under circumstances similar to those mentioned, its origin—whether meteoric or terrestrial—be first determined. It is of some scientific interest to be able to correllate meteorites with geological structure.

H. H. Nicholson.

Lincoln, Nebraska, March 7.

Geology of the Success Mine

The Editor:

Sir—In your issue of January 5 there is a communication from S. R. Moore under the above heading. It may be divided into two parts. The first draws a tentative conclusion from a series of observations extending over a period of years. He says, referring to the idea that granite (monzonite) has been replaced by ore, " from a physical point of view, there always appeared to me to be a doubt, since, in all specimens of granite containing stringers of ore, these are invariably a continuation of quartzite stringers partly replaced, and the question always comes to my mind whether these stringers might not be a replacement of quartzite stringers in the granite, the quartzite having been entirely replaced." To those who may have taken some interest in the controversy as to the priority of the ore and granite in the Success mine, I desire to call attention that this is the testimony of the man who has been superintendent of the mine for a number of years, throughout the period of greatest activity. As testimony, without regard to the conclusion his remarks seemingly imply, it is in line with the position that I have taken in the matter of the relation between the ore and granite.

The second part of Mr. Moore's letter describes a nodule of granite nearly as large as a hen's egg entirely surrounded by ore. He has kindly mailed to me the evidence. It consists of half-a-dozen fragments of dark reddish-brown sphalerite ore. There are traces of galena, pyrite, and chalcopyrite. There are also a number of residuary patches of the rock or rocks replaced. The larger patches at least are unquestionably monzonite. I was unable to fit together the six fragments so as to enclose the 'nodule' nearly as large as a hen's egg, but a patch about an inch long and half as broad certainly disappeared from view when two of the rock fragments were adjusted in accordance with instructions contained in a letter from Mr. Moore. However, this nodule may be connected with the larger one in the interior of the large fragment. Therefore, so far as the evidence now stands, it is not proved that a nodule of granite was entirely surrounded by ore. I have not been authorized to break the large fragment to learn whether the suggested connection exists. If Mr. Moore breaks the fragment and finds such connection does not exist, it does not matter. The ore minerals penetrate the monzonite in a manner to prove conclusively that those in the monzonite are younger than the intrusion. I will go so far as to concede that the monzonite is residuary, probably isolated fragments in the ore. J. B. Umpleby has proved, in a paper published in the February-March number of 'Economic Geology', that such replacement has occurred on a limited scale in the Success mine, but in a later issue of the same journal I take the position that it has been the result of limited migration of the sulphides of earlier veins closely following the intrusion of the monzonite into these veins. It is a mighty simple mineral deposit that does not yield evidence apparently supporting contradictory theories of origin. In this case, I believe the preponderance of evidence is in favor of my view. For instance, I feel inclined to give much more weight to Mr. Moore's observations extending over a period of years, than to his discovery, after these years, of a 'nodule' of granite enclosed in ore.

Oscar H. Hershey.

Kellogg, Idaho, March 10.

Colorado Smelter-Charges

The Editor:

Sir—I note in your issue for March 23 a letter from Ouray regarding the charges made by our local smelters for treating ores. If the writer will read the recent report of O. R. Whitaker to the Smelter and Ore Sales Investigation Committee appointed by the last legislature he will see exactly what has become of that percentage of the value of his ore that he did not receive. This report is most illuminating and should help to do away with the lingering thought in the minds of most shippers that the smelters are getting more than their fair share of the value of the ore they receive. It shows that for the five years, 1912 to 1916 inclusive, the gross value of the metal content of the ore received averaged $26.86 per ton. Of this total $17.95, or 66.83%, was paid to shippers and for freight, the cost of smelting was $4.35, or 16.20%, metal losses were $1.34, or 4.99%, refining and marketing cost $1.66, or 6.18%, leaving an operating profit of $1.36, or 5.80%.

Horace F. Lunt.

Colorado Springs, Colorado, March 23.

Crude oil produced from Scotch shale in 1913 amounted to 1,718,000 bbl., corresponding to a recovery of about one-half barrel per ton of rock treated. The yield of ammonium sulphate, as a by-product, was 300,000 tons from the same quantity of rock. The Scotch shale now supplies large amounts of oil for the British Navy.

Coal-tar, so much used in flotation of ores, is recovered in large quantities from by-product coke-ovens. The tar is also used as fuel for metallurgical furnaces, being fed like ordinary petroleum fuel-oil.

Men and Machinery

By T. A. RICKARD

While I was at Miami, last May, a club building, just completed, was transferred to the Y. M. C. A. management. This event seemed to me to have much significance. An attractive building containing a reading-room, a gymnasium, a swimming-pool, and a number of bedrooms, had been built by the Miami Copper Co. at a cost of $91,000, and Mr. J. Parke Channing, the vice-president and consulting engineer of the company, had contributed an additional $10,000 to furnish it. The building was not at the mine but in the town, and was intended for the use not only of the Miami Copper Co.'s employees, but for those of the neighboring mines and for the people in the town itself. Mr. Channing arrived in time to execute the deed of transfer to the Y. M. C. A., and participated in the opening ceremonies, which were well attended. It was pleasant to note the abstention from any suggestion of patronage, and that the gift was accepted by the people of Miami in the spirit with which it was offered. By making it a Y. M. C. A. club-house the mining company showed good judgment; it saved the employees the irksome feeling of being entertained by their employer, and at the same time it assured the institution an efficient management. Such a club-house in the town, not at the mine, tends to draw the miners and the townspeople into friendly acquaintance; it becomes a conservative factor, because the townspeople desire the prosperous operation of the mine on which their own prosperity depends and therefore they do not favor strikes or other labor disturbances; above all, such a club-house tends to promote Americanization, that is, the assimilation of the foreign elements in our population.

At that time one-third of the working force in the district was American and British, one-third was Mexican and Spanish, one-third was from Austria, the Balkans, and other parts of south-eastern Europe. All received the same pay for the same class of work, but the Mexicans were confined largely to surface work. High wages were being paid at Miami, and men were attracted thereby from other parts of the South-West. The scale of wages was as follows:

$5.40 for miners and mill-men.

$5.90 for mechanics.

$4.65 to $5.15 for white laborers, helpers, and miscellaneous surface-workers, the exact rate depending on individual efficiency and length of service.

$3.65 to $4.15 for Mexican laborers on the surface, the exact rate depending upon individual efficiency.

In passing the office of the foreman at the No. 2 shaft I noticed a line of men awaiting their turn to apply for work. They sat by the roadside, in the warm sun, chatting or smoking. Most of them had come, not long ago, from Servia, Montenegro, Croatia, Dalmatia, Bosnia. They were Slovenes and Jugo-Slavs. A group of Mexicans caught my eye; these, like many others, had crossed the Rio Grande to avoid the dangers of misrule and the even greater danger of starvation. The Miami mine, as has been shown in the technical description of underground methods, employs few miners and these are mostly Americans or British. The lower kind of manual labor—shoveling and wheelbarrow work—is done by laborers to whom the more honorable term of 'miner' is not applicable. By the law of Arizona it is not allowable



THE Y. M. C. A. BUILDING AT MIAMI

to ask a man, when applying for work, where he has been employed previously; it is illegal even for the foreman in one department to dismiss a laborer and then advise the foreman in another department in the same mine not to employ him. It is permissible only to ask the applicant what is his name, nationality, age, whether married or single, how many dependents he has, whom to notify in case of accident, and what kind of work he wants to do. These regulations were enacted, at the instance of the State Federation of Labor, to prevent black-listing. The result is illogical, for the only way left to ascertain what a man can do is to try him. Many men claim to be miners who are not, so that a great waste of time and energy, with considerable confusion, is inevitable. While watching the crowd of 'bohunks,' as they are collectively labeled in the vernacular, I saw a Mexican pass with a number of green leaves on a skewer; these were the young leaves of the prickly cactus, to be eaten like spinach. An occasional Indian strode past, with characteristic gait, throwing the weight of the body forward. The San Carlos reservation is 15 miles away, and the Indians are allowed off the reservation so long as they behave them-



selves; if anyone does not, he is reported to the Agent, and either recalled or brought back. They do not like to stay on the reservation; life there is too monotonous and they can make more money on the outside. The law grants them the privilege of squatting on any vacant land in the district, all of which was once theirs, and they can travel without payment on any train that crosses their former hunting-grounds.

Miami is an ethnical melange; so are most of the copper-bearing districts of the South-West. People there talk about 'nationalities' when they mean races. The laborers from south-eastern Europe are as 'foreign' as the Mexicans, perhaps more so. Not many of them have learned to speak English; they know the few words necessary to take simple orders from a foreman, and they herd together, so that they are slow in acquiring the language and customs of this country. They represent an unassimilated lump in the social economy. Many of them expect to make a little money and return to the country of their origin, but in the end most of them remain and become a part of the ethnic complex out of which the American people is being evolved. It is important that they should be assimilated as rapidly as possible, and to do this no institution is more useful than the Y. M. C. A. club-house, where they learn to speak English and to promote a good understanding with the other members of the national family. Moreover, now that the saloons have become a thing of the past, the workmen in Arizona find it pleasant to have a place where they can foregather. The Y. M. C. A. serves as a rest-house and a social centre; it is particularly helpful to the unmarried men and boys, by whom the gymnasium and pool are keenly appreciated. The humanizing effect and the civilizing influence of such an establishment are understood best by men that, like myself, have known the 'mining camps' of an earlier day, when the saloon and the hotel afforded the only rendezvous.

Extravagance among employees is the natural consequence of higher wages, just as increase of income causes employers to indulge in more luxury. The miner at Miami has not gained much from the high price of copper, if gain be measurable in savings. Formerly he received $3.50 per day and had to spend $2, leaving $1.50, out of which he put aside $1; now he receives $5.40, the cost of living has increased 50%, so that he has a margin of $1.65, but he keeps barely half of it, so that his saving is less than it was formerly. This, of course, is a rough and ready way of stating the economics of the mining community. He has had the fun, however, of spending money, and that is a childish pleasure that most grown men enjoy. At Miami the miner's breakfast costs him 30 cents and his supper 50 cents. The 'lunch' that he takes with him to the mine is usually prepared at a restaurant for 40 cents. A room costs $10 per month. Board and lodging therefore amount to about $46 per month. The miner pays a hospital fee of $1.35 per month and if 25c. be added daily for a round trip by automobile the minimum expenditure is $54.85 per month as against wages amounting to $151.20. I saw a Mexican going to work with a thermos bottle. Speaking of 'lunch,' I met a number of men going to the mine on foot and carrying brown-paper bags containing their mid-day meal, bought at a restaurant. The tin-plated dinner-pail is going out of fashion. I remember seeing paper-bags hanging by a string from the timbers underground; this was done to circumvent the rats. The miners now buy gramophones; they have acquired a taste for the joy-ride in an automobile. A well-informed citizen explained to me that the 'muckers' had Fords, the shift-bosses Overlands, the foremen Hudson super-sixes, and the managers Cadillac eights. It was evident that the buzz-wagon had become a thoroughly democratic vehicle of transport. In the gulch near the Inspiration shaft I saw a dozen automobiles waiting for the men about to go off shift. I met a motor-lorry carrying 40 workers on their way home from a 'graveyard' shift at



Road to Globe Inspiration Mill Miami Mill-dumps International Smelter

the Inspiration. Fully one-half the men employed at that mine go to work in this way, paying $7.50 for 30 round trips. Others travel by 'jitney', paying 35 cents each way, from the mine to Globe. In contrast to these new-fangled ways I saw an old-fashioned wagon and trailer pulled by five pairs of horses, the driver riding the wheel-horse, on the road from the Black Warrior mine to the International smelter. This seemed a curious survival from a bygone day, in comparison with so many technical novelties. Neophobia—the fear of anything new—is not a failing noticeable at Miami. The description of the methods of mining and milling shows initiative and originality, but perhaps the most remarkable evidence of mechanical ingenuity is to be found in the Inspiration compressor-house where two hoisting engines work automatically.

The Inspiration hoist is one of the marvels of Arizona. The visitor enters a large building in which the raising and lowering of the cages in the two twin-shafts of the mine are done without the control of an engineer. The two engines work automatically, independently, and in balance. One starts before the other comes to rest; the engine that is stopping gives an impulse to the idle one. This overlap is variable and adjustable. Each hoist is driven by a direct-current motor the power from which is 'on' or 'off' in accordance with the cycle of movements. As I stood and watched the ponderous mechanism at work with clock-like precision, one drum revolving and coming to rest as the other began its slow revolution, winding or unwinding the heavy steel rope that raised or lowered the cages in the two shafts, I marveled to see the levers move to and fro on the engineer's platform as if operated by spirit hands. It was uncanny. The movement of the hoist shifts the levers, instead of the lever controlling the switches.

Each hoist has one fixed and one clutched drum of 10-ft. diameter by 65-in. face, grooved for 1000 ft. of $1\frac{3}{4}$-in. rope in one layer.* The brakes and clutches are moved by compressed air. Each hoist is operated by a 580-hp. motor electrically connected to a generator set, and the speed of the motor is controlled by increasing or decreasing the voltage from its generator. A 10-ton flywheel $9\frac{1}{2}$ ft. diameter serves to store energy for meeting the high power required when starting the load. Before beginning automatic operations each drum must be clutched in position for the loading-level, one skip in each shaft resting on its chair below the loading-chute. The automatic control is introduced by closing two small switches and locking the two clutch-levers on the engineer's platform. Then the cycle of automatic movements is actually started by means of a master controller, like a street-car controller. This control-lever is moved so as to start the small motor that moves the controller of No. 1 hoist to the full-speed position, and at the same time moves a device that releases the brakes on the No. 1 hoist. As the hoist-controller is moved forward it increases the voltage to the hoist-motor and brings the hoist-drum gradually to full speed, raising one skip in the shaft while the other skip descends. Just before the loaded skip enters the dumping-horns the No. 1 controller, actuated by cams geared to each drum, moves to the 'off' position, reducing the voltage and slowing the revolution of the drums. The operation is so timed that No. 1 controller reaches the 'off' position just as the descending skip lands on the chair under the loading-chute at the loading-level. The retardation is completed and the brakes are applied. Before No. 1 hoist comes to rest, it starts the pilot-motor for the controller of the No. 2 hoist, which then begins a series of movements exactly duplicating those described for No. 1 hoist. To increase the capacity of the plant the electric control is set so that each hoist will start revolving earlier in the cycle of movements. The maximum capacity is 16,000 tons in 14 hours.

*Technical details are given in the paper by H. Kenyon Burch and W. A. Whiting in Trans. A. I. M. E., Vol. LV, pp. 10-24.

To understand the operation of the hoist it is necessary to go underground and watch the automatic loading of the skips, on the haulage-level, at 585 ft. from the surface. Each ore-car holds 5 tons, and itself weighs 3500 lb. A 10-ton two-stage air-driven locomotive pulls 20 cars or 100 tons of ore. The exhaust of the locomotive suggests a railroad train. The track is 40 lb. A. S. C. E. rail and the grade is 0.4% in favor of the load. Instead of link-and-pin connections the cars are equipped with half-size freight-couplers. No roller-bearings are used, only solid brass journals of a miniature railroad type. All the train-men carry whistles about their necks because speech is impracticable amid the uproar made at the loading-station. An Aldrich triplex geared electric pump, lifting 47 gal. per minute, contributes its share of noise, but it is hoped to diminish it by using a rawhide pinion. The ore-car is a plain box. The train of 20 cars moves into a tipple, one car at a time. A springless car is required on account of the necessity for a close fit in the tipple while the car is being dumped. When the load is released, the springs would expand and wedge the car in place. If the ore happens to be so moist as to be sticky it cakes on the bottom, so that cars have to be side-tracked while the caked ore is broken by aid of a pick.

This automatic hoist sets the pace for the mine, compelling all the operations to keep step. Sixteen thousand tons is hoisted per day. A big margin of time is available for loading, so that there is no danger of the skip moving before the 'cartridge', containing the unit of load, is emptied. The skip stays for about a minute. One skip is dumped per 50 seconds.

One may consider that so big and complicated a mechanism should not be trusted to operate without human interference, forgetting that it is the human factor that introduces unreliability and aberrancy. Even clock-like precision has its limits, for a clock needs to be wound. No engineer trusts an automatic machine unless the automatic device comes frequently into operation; disuse may render the stand-by machine ineffective when an emergency does arise. At the Inspiration the mechanical engineer sees that the safeguards applied to the elevators used in hotels and office-buildings have been applied to the operation of a mine-hoist, and he recognizes the fact that the automatic feature is possible only where the conditions of hoisting are uniform; if the ore came from a number of levels, it would be necessary to place an engineer at the control. These hoists can be operated by hand. If one shaft is not in use, on account of repairs to a skip or loading-tipple, for example, an engineer is placed on the platform in the engine-room. As it is, when operating automatically, one chief engineer and three staff-engineers (one on each shift) are employed, and each is assisted by an oiler. Two electricians, one by day and one at night, are in attendance. Thus we see that the automaticity is hedged around with human safeguards. Once a cable broke, whereupon the man in charge pulled the electric switch, which shut off the power, applied the brakes, and held the empty skip from running away. A shift-engineer was walking about, as I saw one at the time of my visit, within reach of the switch-plugs. It is intended to distribute electric-contact buttons over the engine-house so that they can be quickly accessible in case of emergency. The men have the use of a cage traveling in the third compartment of one shaft and operating against the counterweight† moving in the third compartment of the other twin shaft. The cage is a double-deck Otis elevator capable of carrying 36 men, 16 on the upper deck and 20 on the lower. The operator stands on the upper deck, where also are the telephone, annunciator, incandescent lamp, emergency switch, and operating switch, the last being self-centring and coming to a neutral position as soon as the operator's hand is removed from it. A second operating switch is in the engine-room, and by means of it the engineer on the surface can operate the hoist when necessary. At each landing there are 'up' and 'down' buttons, as in a hotel or office-building. These connect with the annunciator facing the operator on the cage. Each landing has a telephone that connects with the cage and with the engine-room; it also has two platforms so that both decks of the cage are accessible simultaneously.

While looking at the Inspiration hoist I was impelled to imagine what an unsophisticated Cornishman would say when he saw it for the first time. Mr. Channing helped me by relating a story of which Capt. James Cundy was the hero. This old Cousin Jack went from the Menominee range to the Hotel Pfister at Milwaukee. Coming out of his room he saw the elevator and did not know how to stop it. A maid was passing, whereupon the following conversation ensued:

"Eer, my deer, 'ow do ee get thay cage?"

"Press the button, Sir."

" 'Ow many times do ee ring?"

"Once."

" 'Ow many times to make ee come hup?"

"Only once, Sir."

"And 'ow many times to make ee go deown?"

"Just the same, once."

"Well now, my deer, where I do come from they rings three times for to go hup, two bells for to go deown, and one bell to stop. Here's a quarter, go's along and buy thee some ribbins."

Various elements in the labor force develop liking or skill for special tasks. Thus the unloading at the smelter is done by Greeks; the roustabouts are either Mexicans or Indians; most of the furnace-men are Irish. The Cornishman is to be found underground, working amicably with the native-born American. I emphasize "amicably" because there have been times and places when and where the relations between the two were not cordial. For example, the story is told that a group of Cornishmen had a mine on lease, or 'tribute', when some

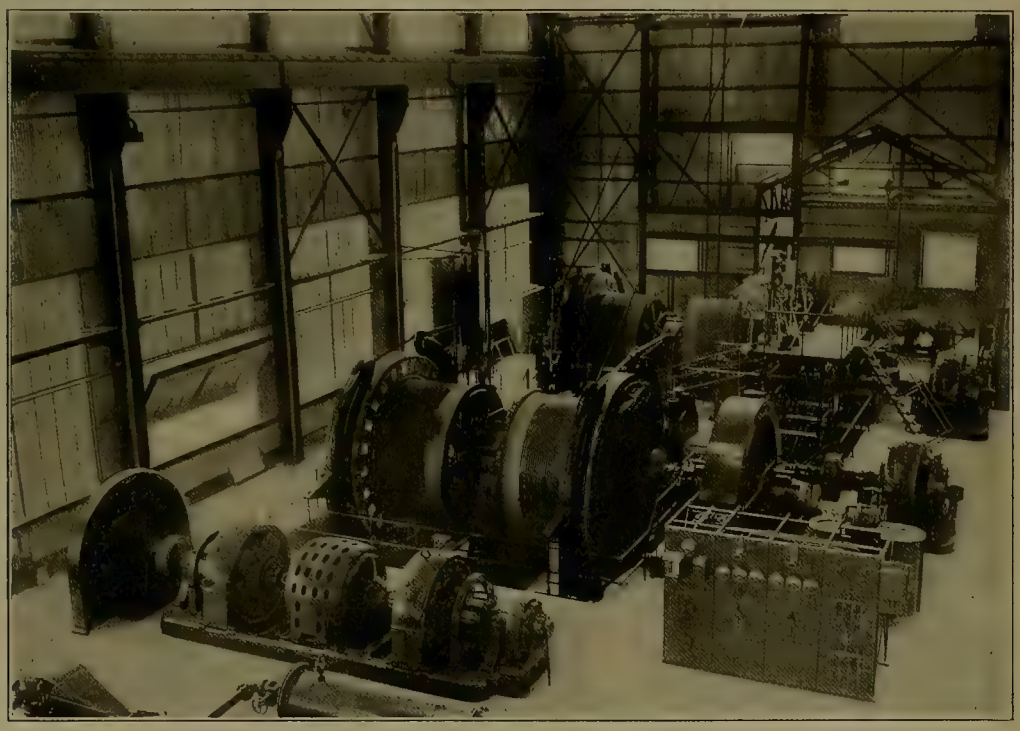
†This is in the form of a small cage that suffices to carry two men for the purpose of inspecting the shaft or making repairs. 'Otis Passenger Elevator at Inspiration Shaft,' by C. E. Arnold. Trans. A. I. M. E., February 1918.

Americans bought the property over their heads and terminated the lease, putting the Cousin Jacks to work on company account. They were disgusted. At a meeting called by the men to discuss the crisis, it was suggested that they test the efficacy of prayer, whereupon one good Wesleyan lifted his voice in supplication, as follows:

"Deer Lorrd, take they bloomin Hamericans and cast they deown to the bottommost depths of 'ell, theer lave they fry and sizzle till they give we our just tribute; then, deer Lorrd, take they hup, greasen they a bit, and put they back hin theer 'igh places."

As Mr. Arnold piloted Mr. Channing and me through the Inspiration mine, I remarked upon the usefulness of such visits as between the technical men employed by neighboring companies. Not only does it promote goodwill, in itself a benefit to the community, but it leads to the comparing of notes and the exchanging of ideas. The hammering sound due to the irregular passage of air through the pipes led Mr. Channing to suggest that if the compressed air be passed through the shells of an old multi-tubular boiler, for example, it had the effect of breaking the impulses from the piston of the compressor and preventing useless noise and waste of energy. The sight of a Rand drill at work with its octagonal steel reminded us of the time when it was necessary to use lugs on the round steel. That simple invention of octagonal steel was a great boon to the miner.

Going from Phoenix to Prescott the train passes a station named Hillside, where I had hoped to see something of a mine of that name with which I was connected professionally in 1892 and 1893, before the railroad was built. It was too dark to see anything, and I was informed that the mine was several miles from the track. The rich vein of complex ore that was mined at Hillside traversed schist capped by basalt—the 'malapai' of the miner in the South-West. John Lawler discovered the vein in a gulch where erosion had worn through the basalt into the schist, and the later workings of the mine had been extended under the basaltic blanket. The question arises whether many rich ore deposits may not lie covered by such Tertiary and Quaternary flows of lava,



THE INSPIRATION HOISTING ENGINES

and whether the time may not come when systematic boring will be undertaken in the search for such hidden wealth. The story of the U. V. X. mine, at Jerome, gives further point to this suggestion, for there the lava was not only the surficial rock but overspread the limestone under which, if the limestone had been visible, the existence of the ore-bearing schist might have been more quickly inferred.

At Prescott I found the old Burke hotel had changed its name and on the door of the bar-room the traveler read the significant notice 'Out of Order'. It seemed strangely quiet compared with the lively times of 25 years ago. But Prescott itself can boast a handsome new Court House and retains the air of a comfortable hometown. It is just a mile above sea-level and enjoys a climate as near perfection as anyone would wish. The Thumb Butte and the other granite hills provide an

agreeable background, and, on the whole, I confess to having been to few mining centres so agreeable as Prescott.

From there the railway runs through granite country, exposing clean-looking massive bouldery outcrops rising above a high-level plain, which must have been a lake-bed, as is suggested by the conglomerate detected in a railroad cutting. The train crossed these sunlit uplands toward a range of hills darkened with forest and shadowed by clouds that had distilled a shower of fresh snow, now graying their summits. At Jerome Junction the traveler for Jerome leaves the main northward line and takes a crawling narrow-gauge train that winds its devious way from the high plateau into the valley of the Verde. On his way he sees the succession of rocks constituting the geologic terrain of the rich copper mines at Jerome. A trench and a prospector's stake near the railroad explain man's irruption into this vast desolation, for, as the train follows a descending contour, the intermittent views of the wide Verde valley and the opposite mountains of the San Francisco range afford a perspective so expansive as to emphasize the insignificance of human interference with the order of nature. Soon a winding ribbon of green cultivation is discerned far below in the valley, and the smoke emerging from a black chimney marks the Clarkdale smelter, where the ore of the United Verde is treated. Formerly the smelting was done at the mine itself and the effects of the fume made by heap-roasting are to be seen in the barren darkly red slopes over which the railroad reaches its terminus. The train stops suddenly at a small freight-shed on the edge of a big open-cut. The traveler finds himself high on a mountain-slope close to the old workings and the abandoned slag-dump of the United Verde mine, overlooking the dreary hillside to which the little town of Jerome clings in sheer desperation. Senator Clark has provided as unpleasant a terminus for his railroad as any that I have seen. He dumps the arriving passenger upon a bleak mountain and tells him to shift for himself. Luckily, I did not have to do that, for at once I became the beneficiary of Mr. James S. Douglas's hospitality. In other articles I have described the famous enterprise that Mr. Douglas has created and that has led him to build a graceful *casa* on the ridge reaching forth from the malapai slopes through which he has penetrated in his successful search for copper ore.

At Jerome one sees more of the labor problem and of the even greater problem of Americanizing the heterogeneous foreign elements that do so much of the work of mining. While I was at Jerome a strike was started, the unskilled workers demanding the Miami scale of wages. That did not seem unreasonable, for Jerome is a worse place for living than Miami. The difficulty was not faced firmly by the management of the United Verde, largely because the owner of that mine lives in New York, and apparently the resident manager was not free to act on his own judgment. Hence the representatives of the miners were referred first to New York, then to Los Angeles, where Senator Clark's son lives, and then back to the resident manager, and in the process of postponement and indirection the labor leaders became irritated. The question of striking was put to the vote, but less than a third of the men cast a ballot, for fear of committing themselves, and a large number of the steady workers left the town rather than participate in the trouble that was impending. I heard one of the labor leaders—an 'agitator'—make a speech from a band-stand in what might be—but is not— a park in the centre of the town and I discussed the matter with one or two of the managers, coming therefrom to the conclusion that the friction between employers and employees could have been avoided by the prompt display of firmness and fairness. Why a car-man or a chuck-tender living in such a miserable place as Jerome should be content with a lower wage than is paid for the same work at Miami, I do not see. At Jerome a decent room for a single man costs $20 to $25 per month. Two men can share a small room for $20. Good board costs $1.25 per day, the average being $8 per week. Supplies of all kinds are costly, partly because the town is served by a railroad that is controlled by the owner of the United Verde mine. The distance to Prescott is 65 miles by an automobile road; if a direct railroad connected Jerome with Prescott there would be easy access to a pleasant town and reasonable amusement, but the store-keepers at Jerome fear a diversion of trade and the Clark interest would object because it would interfere with the control exercised by the existing railroad.

Speaking of costs, Mr. McGregor told me‡ that the expenditure to be made on the United Verde Extension company's new smelter in the Verde valley would be just double what it would have been five years ago. The higher price of labor, and the lower efficiency, doubled the cost of grading. Likewise structural steel cost twice what it did when the Calumet & Arizona smelter was built, and the other parts of the equipment cost 2½ times as much. This smelter, by the way, is to have a capacity of 1000 tons of ore daily; it is to make a 38 to 40% matte. The ore contains a slight excess of silica and will require the addition of lime, which is plentiful near the site of the plant, seven miles from Jerome. The ore at present is delivered by a Leschen tram, 4600 ft. long, to the railroad, thence to the smelters at Bisbee, Humboldt, Douglas, and Globe. The U. V. X. smelter will cost $2,250,000.

While visiting the smelter-site I was introduced to an Apache of pure breed, named George Washington Hunt. He was born near-by, at Cottonwood, on the Verde river, and was working as a junior engineer in charge of the grading. He spoke good English, having been educated in the Indian school at Grand Junction, Colorado. The dignity and natural poise of this real American were pleasant to observe, contrasting agreeably with the mixed submissiveness and impudence of the riff-raff from southeastern Europe.

‡See also 'Features of the New Copper Smelting Plants in Arizona.' Trans. A. I. M. E., Vol. LV, pp. 781-805.

Jerome, as seen from below, appears as a cluster of yellow, blue, and white boxes on stilts clinging to a barren hillslope. Until 1897 Senator Clark roasted his ore in heaps and made a hades of the place where his work-people lived. On nearer view Jerome does not improve. It is a blot on our democracy that citizens should live amid such surroundings. The muddy roadway that served as a street, the crowded dirty sidewalks, the polyglot population, left an impression of industrial conditions that are in a rudimentary stage of development. The mining companies ought to build houses for their employees and try to do something to establish a reasonable standard of living. It is a manifest social wrong for a few men to draw wealth from these mines — from two of them at least—and live, as most of the owners do, in luxury in distant cities, while the work-people have to exist like castaways on a deserted island in the midst of this desolation, without any apparent attempt being made to mitigate the natural discomforts of the locality.



THE MAIN STREET OF JEROME DURING THE STRIKE



JEROME AND THE UNITED VERDE MINE

Passing with Mr. Douglas through the crowd along the muddy thoroughfare it was interesting to note the contact between the millionaire mine-owner and the men he employed, many of whom he had known in other parts of Arizona. "Hullo Jim," and "Hullo Dick, Tom, or Harry," as might be, were the salutations that passed. Mr. Douglas has found no difficulty in determining his attitude toward those less fortunate than himself. His democratic manner has not lost him either the dignity or the respect that is the meed of a successful captain of industry. On turning to the list of members of the American Institute of Mining Engineers, I find that James S. Douglas described himself as 'miner.' With that label I feel inclined to quarrel as incorrect, for I know him to be an accomplished technician, fully competent to devise and direct the operations of mine and smelter. If he were a 'miner,' without further ado, he would not be a member of the Institute. Still I like the sincerely democratic spirit shown by him in all that he does, now that I know him to be solicitous for the welfare of the men he employs and willing to leave his profitable enterprise at Jerome in order to do such work as an American of his age can perform 'somewhere in France.' Such men as he, with their recognition of the duties of citizenship, are likely to contribute to the solution of the problems that will perplex our industrial democracy with increased insistence when we have won the War.

The Metallurgy of Mercury

Furnace treatment will continue to be the method used for recovering mercury from cinnabar ore, as indicated in the discussion at a recent meeting of the San Francisco Section of the American Institute of Mining Engineers. With improvements in calcining and condensing, the two essential operations in current practice, the old process will prevail. Wet methods of extraction cannot compete in cost of operation with reduction by means of present furnaces. As a result of co-operation between the California State Mining Bureau, the U. S. Bureau of Mines, and the companies producing quicksilver, a series of investigations has been made during the last three years, and two publications on the subject will be issued soon. At the meeting mentioned, W. W. Bradley, of the State Mining Bureau, who has had charge of the research, gave some valuable information. Of the 20 species of mercury minerals, only three are of commercial value, namely, cinnabar, meta-cinnabar (the black sulphide), and native quicksilver. There is little literature on the metal. Its metallurgy is simple. Producers have been satisfied with the recovery, and up to 1916 little sampling and assaying had been done to determine the percentage obtained. No systematic investigation in concentration was done until 1913. For calcining ore, the D-retort is useful only for high-grade ore and concentrate. The Scott furnace was designed in 1875, and may be styled the standard in California. It consists of a shaft in which are tiles or shelves set at an angle, staggered, down which the ore travels to the bottom, where the fire-box is placed. Ore is drawn out at intervals. The disadvantages are considered to consist in too much handling and too much time consumed—24 hours being required for the ore to pass through. This furnace should not be used for drying ore. Until recently, fuel economy and temperature control have not been studied, and pyrometers should be installed. The consumption of too much air increases the consumption of fuel and is a detriment to the condensing system. The absorption of mercury is large where brick and cement are used in the furnace. The cost of operating the Scott furnace is from 50 to 75c. per ton, plus 25 to 50c. for other charges. The recovery from one ore, assaying from 0.26 to 0.36% mercury, was 91.3%, and at another, under careful supervision, treating 0.66% ore, it was 86.6%, but Mr. Bradley said it was doubtful whether over 75% has been recovered by average furnace practice in California. He stated that revolving furnaces had not been successful, although at New Idria one recently erected is working well at present. In multiple-hearth furnaces, such as the Herreshoff, dust was a nuisance; but with the Cottrell precipitator this was avoided. At Almaden one of these furnaces is now at work. Condensers have been constructed of brick, but wood is preferable, as it does not absorb mercury. Condensing methods have been erratic in the past. The vertical circular wooden tank seems to be the best condenser. It is necessary that the fume be cooled as soon as possible after leaving the furnace. The introduction of cooled air is advantageous. Tests made at the University of California showed that in wet concentration of cinnabar the feed must be classified before passing to tables. 'Paint' cinnabar cannot be collected by tables, but the native metal can. By flotation, paint and slime ore can be collected. The specific gravity of cinnabar is 8, yet quicksilver miners considered concentration impracticable. Concentrate must be roasted, but if the mercury content is too high, that is, as much as 40%, this product packs in the furnace. A wet plant would cost half as much as a furnace plant. Sodium sulphide will readily dissolve quicksilver and the sulphide, but the process is not applicable in the presence of a considerable quantity of ochre. The Bureau of Mines, according to L. H. Duschak, first made a study of losses in fume. These were found to be surprisingly small. At New Idria, on 1% ore, the loss was but 4½ lb. per 24 hours. At the Oceanic mine it was 6½ pounds. Water losses, that is, mercury dissolved by acid vapors from calcining, were very low. Condensing consists of two operations, namely, cooling and collecting. Baffling the fume is essential. Good furnace work should yield a clean residue, and at least 90% of the metal should be expelled. At Idria, in Austria, the recovery is 95%. A temperature of 600° C. will expel mercury from one-inch ore in 15 to 60 minutes. Mr. Duschak has great hopes for rotary furnaces. These cost $250 per ton of capacity against $1000 for the Scott type, the consumption of fuel is one-third to one-half that of the Scott, labor is one-fifth to one-fourth, and the furnace is automatic. H. W. Gould, of New Idria, said that the rotary furnace has great possibilities. It is more flexible than the Scott, the ore passes through in 15 to 30 minutes, and there is no mercury left in the tailing. There are no absorption losses in the furnace, as all the brick is hot. There is no personal element attached to the rotary, as the discharge is automatic, whereas in the Scott this is irregular. The furnace now working at New Idria is 4 by 50 ft.; it makes from 1½ to 4 revolutions per minute, and treats 96 tons of 1¼-inch ore daily. No salivation of the workmen is possible on account of the joints at each end of the furnace. The new rotary being installed is 5 by 60 ft. Clifford G. Dennis, of the St. John mine, said that his experience was that assays of cinnabar were not satisfactory, in that condenser operations were so erratic that he had recovered as high as 330%. This was due to metal 'hanging up' in the walls of the condenser, and dropping irregularly, preventing checking actual recovery with the theoretical. E. A. Hersam championed the past work of quicksilver producers, praising the work of the Scott furnace. He thought that sampling and assaying cinnabar was much different from that of other ores, and should be done in greater bulk. He has more faith in furnace results than in assays.

POTASH is in strong demand at Pacific Coast points. Sulphate of potash commands $350 per ton for the 90% grade, and a recent shipment from Japan sold at $396.

Testing an Air-Compressor

By WALTER S. WEEKS

When a compressor is sold it is guaranteed to have a certain volumetric efficiency by orifice test.

This efficiency is determined as follows: The air delivered per minute by the compressor is measured. The volume of this air is calculated under the conditions that prevailed at the intake of the compressor. This volume is divided by the volume swept per minute by the piston of the low-pressure cylinder. The result is the efficiency sought. The piston rod should be neglected.

The term volumetric efficiency is also used in comparing the performance of a compressor at different altitudes and with different intake temperatures. This use of the term is in my opinion unnecessary and confusing. The whole subject may be clarified by using the term 'volumetric efficiency' only for that given by the orifice test and stating the air-consumption of tools in cubic feet of compressed air at a given gauge-pressure.

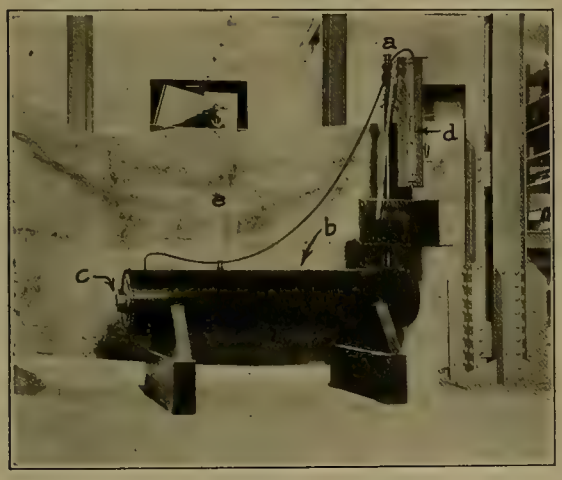


FIG. 1. COMPLETE AIR-METER

An example, if I may digress for a moment, would be something like this: An air-drill requires 10 cu. ft. of compressed air at 90-lb. gauge. The altitude is 10,000 ft. The temperature of the mine is 100°F. The temperature of the compressor-room is 60°F. What must be the displacement of the low-pressure cylinder to run 10 drills? The volumetric efficiency of the compressor by orifice test is 80%.

Compressed air needed $10 \times 10 = 100$ cu. ft.

Ratio of compression at 10,000 ft. $= \frac{90+10}{10} = 10.$

Free air needed $= 10 \times 100 = 1000$ cu. ft.

1000 cu. ft. is needed in the mine at 100°F. It is 60° in the compressor-room, so the free air at the temperature at the compressor-room is $\frac{520}{560} \times 1000 = 929$. The compressor will deliver, at this altitude, according to the maker, only 80% of the piston-displacement, hence the displacement needed is $\frac{929}{0.8} = 1161$ cu. ft.

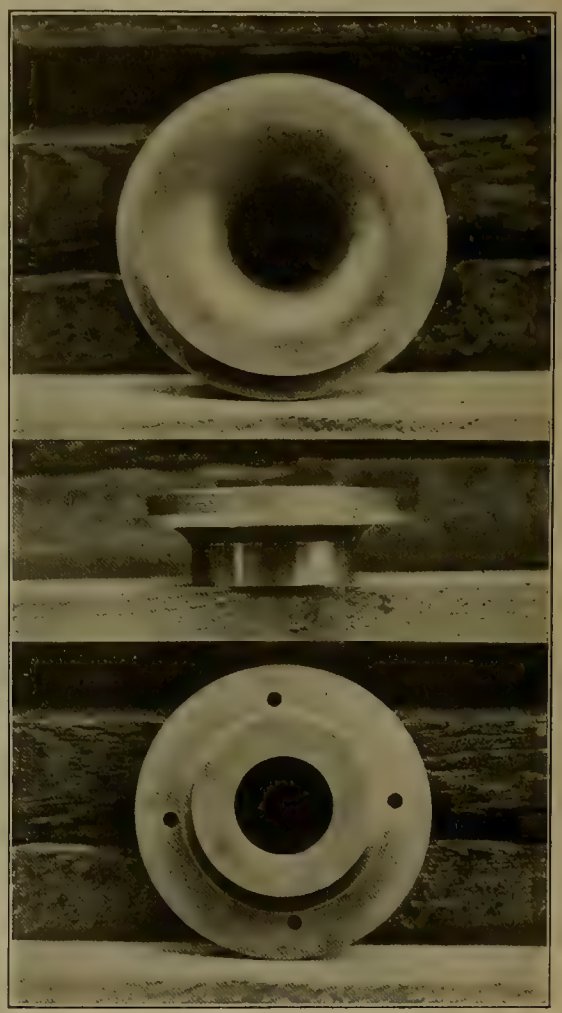


FIG. 4. THE NOZZLE

The vital questions about an air-compressor are: How much does the compressed air cost, and is the compressor doing all that it should?

To answer these questions we must measure our power input, we must measure the air delivered, we must take

indicator-cards on the air end, and determine the displacement.

The measurement of power on the driving side is familiar to all, but a rapid way of measuring the air may not be quite so familiar. The air is best measured by what is known as the low-pressure orifice method (Fig. 1). All the compressed air that the compressor will make is discharged from the receiver through a valve *a* into a tank *b* in which is placed a nozzle or orifice *c*. The valve is closed until the compressor will just hold the receiver pressure desired. The pressure just back of the nozzle is taken with a water manometer *d*, and its temperature is taken with a thermometer *e*. From these data, with the size of the nozzle, the air flowing per minute may be computed.

The flow through an orific is assumed to be adiabatic, but an adiabatic formula is cumbersome. If we assume that the density of the air is a mean between the density inside and outside the tank, a simple formula can be developed from the basic principle that $V = \sqrt{2gH}$. This simple formula agrees with the adiabatic formula up to 18 in. of water. A discussion of the development of the simple formula may be found in 'Engineering Thermodynamics,' by C. E. Lucke.

The formula there given is pounds of air per second through a circle of

$$d \text{ in. diam.} = 0.01366\ d^2\sqrt{\frac{h_w P}{T}} \text{ (No. 1).}$$

d = diam. of nozzle in inches.

h_w = difference in pressure on the two sides of the nozzle in inches of water (never over 18 in.).

P = mean pressure on the two sides of nozzle in lb. per sq. ft.

T = absolute temperature back of the nozzle in degrees F.

What we are after is the cubic feet of free air delivered per minute under intake conditions. Curves may be plotted to make our computations easy.

To find the weight per minute multiply by 60

$$W = 0.81960\ d^2\sqrt{\frac{h_w P}{T}}$$

First assume the nozzle to be 1 in. diam., the nozzle temperature 60°F., the barometric pressure 14.6 lb. per sq. in., and determine the weight that will flow out per minute with water-gauges from 1 to 15 inches.

After these weights are determined, calculate the volumes under a standard set of conditions by the formula

$$V = \frac{w R T}{P_s}$$

V = volume in cu. ft.

w = weight in lb.

R = 53.34

T = absolute temperature = 520°F.

P_s = absolute pressure in lb. per sq. ft. = 14.6×144 = 2102.4.

We now have the data for curve *A* (Fig. 2). The values plotted include a coefficient of flow for the nozzle of 0.98, which from various investigations appears to be reasonable.

Now suppose the nozzle temperature instead of being 520° abs. is some other temperature T_1 abs. We can determine the flow by multiplying the values on curve *A* by $\sqrt{\frac{520}{T_1}}$. The air after making this correction will still be measured at 60°F. This correction is plotted in curve *B*.

Now suppose the barometric pressure is not 14.6 but some other pressure P_1 lb. per sq. in. In formula No. 1 P is the average pressure in lb. per sq. ft. Let Pm_1 be the average pressure in the same units when P_1 is the

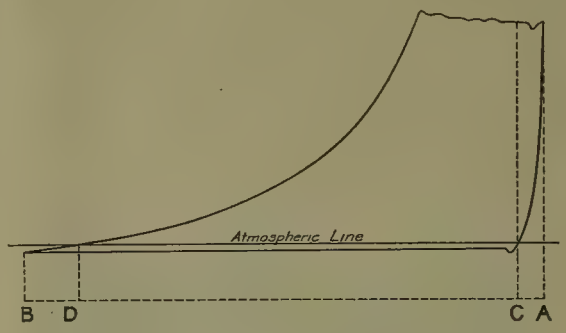


FIG. 3. LOW-PRESSURE INDICATOR-CARD

barometric pressure. The flow of air when the barometer is P_1 may be obtained by multiplying values from curve *A* by $\sqrt{\frac{Pm_1}{P}}$

Without appreciable error we may use the ratio of barometric pressures instead of the average pressures. So we may multiply by $\sqrt{\frac{P_1}{14.6}}$ instead of $\sqrt{\frac{Pm_1}{P}}$

After making this correction the air would still be measured at 14.6 lb. per square inch. We want the volume at pressure P_1 so we must multiply by $\frac{14.6}{P_1}$; thus the total correction will be $\frac{14.6}{P_1} \times \sqrt{\frac{P_1}{14.6}} = \sqrt{\frac{14.6}{P_1}}$

This correction forms the basis for curve *C*. I have used inches of mercury for the barometer pressure because most aneroid barometers read this way.

After making the corrections for nozzle temperature and barometer we have the air at 60°F. and at the barometric pressure existing. There remains still to compute the volume at the intake temperature. This correction is merely the ratio of the absolute temperatures and is plotted in curve *D*.

The final result must be multiplied by the square of the diameter of the nozzle in inches.

Example of the use of the chart.

Nozzle 2 in. diam.

Water column 8 in.

Nozzle temperature 80°F.

Barometer 30 in

Intake temperature 90°F.

Curve *A* 60.6 cu. ft. at 14.6 lb. per sq. in. and 60°F.

Curve *B*, 0.981.

Curve *C*, 0.995.

Curve *D*, 1.058.

Square of diam., 4.

Total correction, $0.981 \times 0.995 \times 1.058 \times 4 = 4.131$.

$4.131 \times 60.6 = 250.34$.

The nozzle then is discharging each minute 250.34 cu. ft. air at 90°F. and 30 in. of mercury. This figure divided by the displacement gives the volumetric efficiency.

Let us suppose that we are testing a two-stage compressor driven by a belt-connected induction-motor.

An indicating wattmeter gives the power-input.

The air-cylinders should be fitted with indicators.

Tests should be run at various gauge-pressures. Let us suppose we are running a test at 90-lb. gauge.

All gauges should be calibrated. Discharge all the air that the compressor makes through the nozzle and adjust the valve to the tank till a pressure of 90 lb. is maintained in the receiver. Let the compressor run under these conditions for 15 minutes. Read wattmeter, water column, nozzle temperature, intake temperature, barometer, r.p.m., and take indicator-cards.

The horse-power calculated from the indicator-cards divided by the horse-power input gives the over-all mechanical efficiency.

From the cost of power, the kilowatt input, and the air delivered, may be calculated the cost of compressed air per unit.

The air delivered divided by the displacement of the low-pressure cylinder gives the volumetric efficiency.

With the aid of the low-pressure indicator-card we can determine the slippage.

The actual volume of air taken in each stroke at atmospheric pressure is represented by the length of the atmospheric line included in the indicator diagram. Glancing at Fig. 3: if *A B* represents a displacement volume *K* then the volume of air taken in each stroke at atmospheric pressure is $\frac{C\,D}{A\,B} \times K = L$.

Less air is taken into the crank end of the cylinder

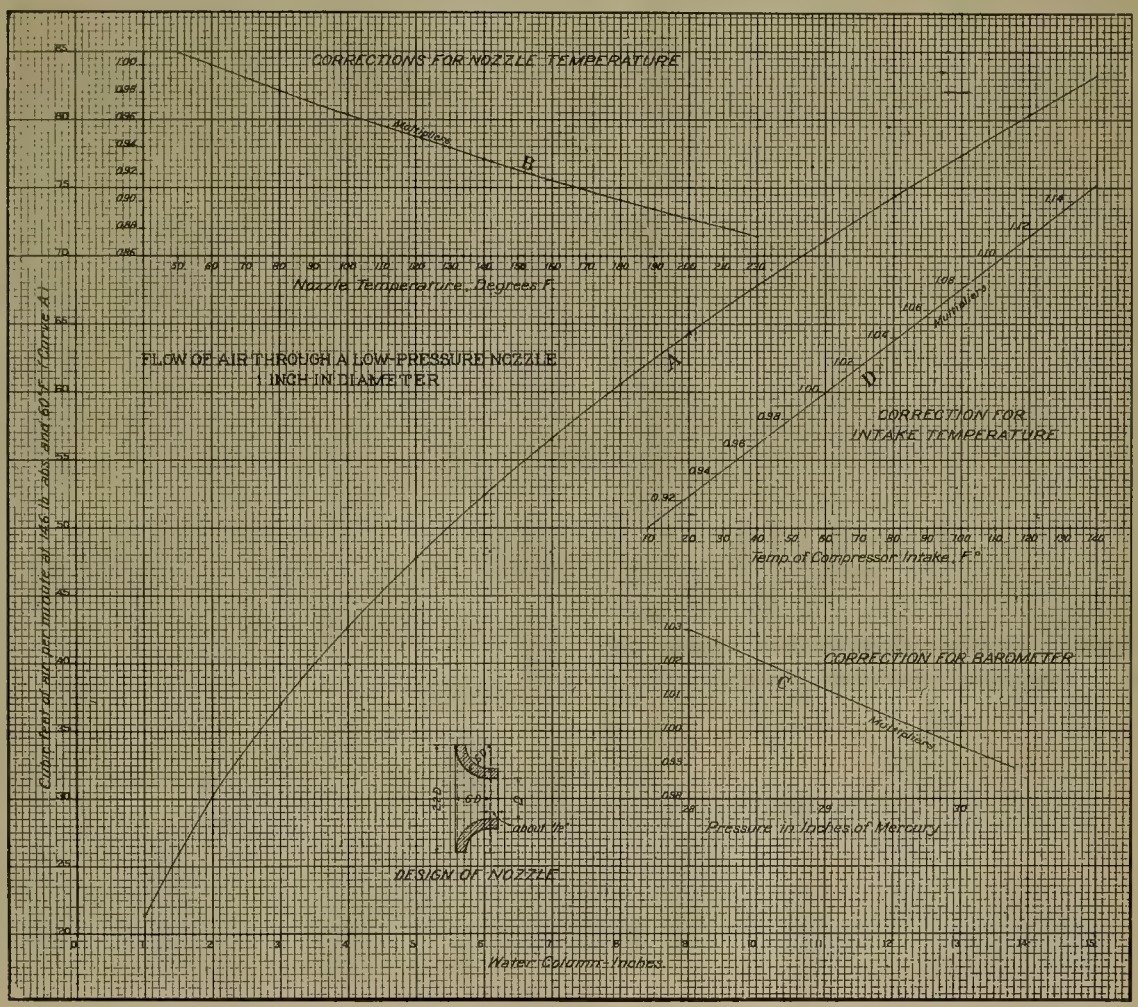


FIG. 2. CHART OF NOZZLE-DISCHARGE

than into the head end because the piston-rod takes up room; therefore the displacement of each end must be figured separately.

Let L_1 = volume at head end at atmospheric pressure.

Let L_2 = volume at crank end at atmospheric pressure.

Let S = r.p.m.

Then the number of cubic feet of air that actually enters the compressor each minute at atmospheric pressure is $(L_1 + L_2)\ S = M$.

The air delivered as measured by the nozzle divided by M gives what is called the slippage efficiency. It is assumed that the air is not heated on its way into the compressor. The air must be warmed somewhat, just how much in a fast-running compressor, I don't know. A little study will show that the warming of the air will make this efficiency appear lower than it really is. Even if the method is not rigidly accurate, it will detect leakage by the piston and through the valves.

S. B. Redfield, testing engineer for the Ingersoll-Rand Co., to whom I am indebted for much information, has used a similar chart for many years in testing the many compressors turned out by the plant, and has found the method most satisfactory. On the chart is a sketch of the nozzle adopted by Mr. Redfield. Fig. 4 is a photograph of a nozzle. A casting should be made of brass and the nozzle threaded to screw into the tank. The nozzle should be polished. For a test a nozzle should be selected to keep the water gauge less than 15 inches.

The area of the tank should be twenty times the area of the nozzle. An even flow through the tank is desired. The globe valve admitting air to the tank may be made delicate by fastening a long lever to the handle. When a compressor is purchased, specification should be made that it be tapped for indicators. These holes are handy in testing the tightness of valves and pistons.

It would be an excellent idea if the makers of air-compressors would agree on a standard method of testing. As the case stands at present a comparison of guarantees is impossible because the compressors are tested by different methods. The important guarantee of a compressor is the horse-power input per 100 cu. ft. air delivered. The way that the air is measured should be carefully scrutinized.

In order that curve *A* may be plotted to a more open scale, I append the values from which it is plotted.

Water-column in inches	Cu. ft. of air	Water-column in inches	Cu. ft. of air
1	21.32	9	64.28
2	30.17	10	67.79
3	36.97	11	71.15
4	42.72	12	74.31
5	47.79	13	74.36
6	52.39	14	80.41
7	56.62	15	83.28
8	60.57		

GOLD HOLDINGS of Japan on December 15, 1917, amounted to Y1,093,000,000, of which Y631,000,000 is held abroad (1 yen = 50 cents).

Deepest Well in the World

The deepest well in the world, already 7363 ft. deep, is now being drilled on the Goff farm, 8 miles northeast of Clarksburg, West Virginia. Until January 24 the record had been held by a boring at Czuchow, Silesia, 7349 ft. deep. The drilling is still in progress and sufficient length of cable and adequate power and tools are at hand for driving still farther into the crust of the earth. The depth of this well exceeds the height of Mount Washington (6293 ft.), and it is over half a mile deeper than the Grand Canyon of the Colorado in Arizona. The well goes farther down than the deepest mines in Michigan, Brazil, or Europe. Several oil-wells in California, in the South-West, in West Virginia, and in Pennsylvania have exceeded 4000 ft. in depth, and one near McDonald, Pennsylvania, 14 miles west of Pittsburgh, reached 7248 ft. below the surface. C. E. Van Orstrand, of the Geological Survey, found that at a depth of 7000 ft. in the well the temperature is 152° F. and that the rate of increase at this depth is about 1° in every 51 ft. This shows that the outer crust of the earth in this region is relatively cool, for in many other regions the temperature increases more rapidly. Mr. Van Orstrand estimates that the temperature of the rocks beneath the Goff well will be found at the boiling point (212° F.) at a depth somewhere around 10,000 ft. The Goff well is near the centre of the great Appalachian coalfield basin, or trough, and is being drilled in search of deeper oil-sands than have yet been reached in this part of the basin. The most hope is based on the Clinton sand, a formation of Silurian age, which is prolific of gas and oil across central Ohio from Cleveland nearly to the Ohio river. From its outcrop this formation dips gently to the south-east beneath younger formations. If the drill can reach the Clinton sand beneath the Goff farm, which is on an anticline in the shallower strata, it may find gas or oil under tremendous pressure. If the well strikes a valuable oil or gas pool in the Clinton sand in this part of the basin it may lead to the development of new reserves that may open a new era in the history of the Appalachian oil and gas region.

BY-PRODUCT AMMONIA from coking is recovered as ammonium sulphate. The present output is 200,000 tons of the sulphate annually. Additions to by-product coking equipment in this country will double the production during 1918. If all coking were done in by-product ovens the quantity of ammonium sulphate available in the United States would be about 700,000 tons per annum.

THE PHENOMENON of life has been shown by Amé Pictet to depend upon that structure of an organic molecule in which the atoms are disposed as an open chain. So far as concerns its chemical relations death is accompanied by a change in the molecule that closes the chain, that is, causes cyclisation of the elements of the protoplasm.

Loss of Quicksilver in Gold Mills

By W. J. SHARWOOD

The death-knell of the stamp-mill and the amalgamation process has been so often and so loudly rung by vendors of rival machines and inventors of rival processes that one might almost suppose them to be obsolete by this time. Stamp-mills, however, continue to crush nearly all the gold ore in the world, and amalgamation is responsible for about a quarter of the gold produced in the United States, and for a still larger proportion of that extracted abroad. Mercury therefore maintains its importance in gold metallurgy, though at the present high price there is a natural and increasing tendency to substitute non-amalgamation processes wherever possible.

Much of the mercury used in the stamp-mill, whether fed into the mortar or sprinkled on the plates, is collected again in the form of amalgam and condensed when the latter is 'retorted.' Only a trifling amount remains in the retorted sponge, to be volatilized and lost in melting the bullion. A larger amount is carried off in the tailing, mostly mechanically as floured quicksilver or amalgam, but partly in the form of smears on the surface of particles of ore, and sometimes partly converted into oxide or sulphide. Some of this accumulates in odd corners, or is caught in traps, and cleaned up from time to time. In the cyanide process part of the mercury in the tailing is dissolved, re-appearing later in the precipitate, from which it is sometimes profitable to recover it by distillation. A certain irrecoverable loss occurs, principally in the tailing, but in modern mills, operating on low-grade gold ores, the loss per ton crushed usually ranges from about 0.005 to 0.01 pound avoirdupois, or, say, 0.07 to 0.15 oz. troy. At the prices current for some years before the present war the cost of an ounce of mercury averaged 4 cents, a flask containing about 1100 oz. troy. Since the outbreak of the War the price has more than doubled, averaging about 8 to 10c. per oz., and at times has been much higher. In former times, when milling high-grade ores with small plate-areas, the losses were often much larger, while the various amalgamation processes (pan, patio, barrel, etc.) applied for treating rich silver ores, consumed enormous amounts, both mechanically and chemically, especially in the days when mercury was allowed to act both as reducing agent and collector, directly replacing silver in the compounds treated.

The accompanying table is the result of an attempt to collate some of the available data on the consumption of mercury in stamp-mills of both past and present. The endeavor has been made to reduce all figures to the basis of troy ounces of mercury per short ton. In a few instances the original writers have not specified clearly what sort of ounce or ton they meant, but the errors possibly introduced in this way are not of serious importance (see table below).

Older data on Australian mills are given by. A. G. Lock, 'Gold: Its Occurrence and Extraction,' pp. 638 and 1019.

A few special cases involve conditions different from ordinary stamp-mill practice, and may be separately considered (see table on next page).

Not much information is available as to the relative amounts of mercury used in the mortar, on the plates, etc., but some data have been published on the practice at the Homestake and Alaska mills. The former use inside amalgamation and have an unusually large outside plate area, averaging 240 sq. ft. per 5-stamp battery; the latter, before abandoning the use of mercury, also amalgamated in the mortar, each 5-stamp battery having a plate of 45 sq. ft. surface and two vanners carrying 18-in. plates.

The ultimate consumption or loss of mercury is no doubt influenced to some extent by the richness of the ore, by the area and slope of the plates, and the relation between their width and length, but more by the condition in which they are maintained as to 'dryness' or 'hardness.' Other factors are the manner of feeding the

	Oz. per ton	Authority
Cement gravel, Nevada county, California	0.05	(1)
Crushing in cold cyanide solution, Liberty Bell, Colorado	0.12	C. L. P.
Crushing in warm cyanide solution, Liberty Bell, Colorado	0.20	C. L. P.
Arrastra, Pestarena, Italy	6.7	T. A. R. (9)
Arrastra, Tuolumne county, California (short run)	8.0	(1)
Combination process, Montana Mining Co., Marysville, Montana; stamping, concentrating, and treating tailing by pan amalgamation; silver with copper minerals and gold	3.0	R. H. R.
Tremain steam-stamp, Gunnison county, Colorado	2.0	E. A. S.
Tremain steam-stamp, using sodium-amalgam	1.0	E. A. S.
Ball steam-stamp in Homestake mill, South Dakota	'Excessive'	T. A. R.
Patio process, Zacatecas, Mexico, 1900	2.76	H. F. C. (11)
Boss continuous pan-process, El Bote, Mexico	2.0	H. F. C. (11)

mercury, whether into the mortar or outside only, the frequency of removing amalgam and dressing or brushing the plates, the kind of traps used and the attention paid to them. The nature of the ore treated, apart from its gold content, is also an important factor, pyritic minerals generally tending to increase the loss. In small-scale laboratory tests it is, however, noticeable that highly sulphuretted ores often cause less flouring and fouling of the mercury (commonly due to formation of a film of sulphide) than those containing a smaller proportion of sulphide that is in a partly oxidized condition. Pyritic concentrates, when run through a mill after becoming partly oxidized by storage, cause rapid discoloration of plates. No particular sulphide, speaking generally, seems to cause more fouling of the mercury than another, though in individual mines or districts such an effect may be apparent.

QUICKSILVER USED AND LOST IN HOMESTAKE MILLS (C. & S.)

Character of ore	Average	Low-grade oxidized	Fair-grade unoxidized
Fed to mortar, oz. per ton	0.30*	0.27†	0.33*
Recovered from retort	0.37	0.18	0.50
Loss	0.132	0.085	0.17
Gold amalgamated per ton	$2.92	$1.93	$3.70

*Additional mercury was sprinkled on outside plates, and used in cleaning up.

†An additional 0.08 oz. mercury on outside plates.

DISTRIBUTION OF QUICKSILVER USED IN ALASKAN MILLS (12)

Mill	240-stamp	300-stamp	Ready Bullion	700-Foot	Alaska Mexican
Fed to mortar, oz. per ton	0.1747	0.1792	0.1787	0.1138	0.1731
Plates	0.0143	0.0179	0.0079	0.0164	0.0114
Vanner plates	0.0015	0.0012	0.0031	0.0018	.....
Cleaning amalgam	....	0.0238	0.0268	0.0534	0.0344
Total used	0.1905	0.2221	0.2165	0.1854	0.2189
Loss	0.0690	0.0820	0.0770	0.0470	0.0600

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LOSS OF QUICKSILVER IN STAMP-MILLS

	Oz. per ton	Authority	Character of ore
ALASKA:			
Treadwell, prior to 1900	0.13	H. L.	
" 240-stamp mill, 1903–04	0.074	Annual Reports	Ore $2.65 per ton
" 300-stamp mill, 1903–04	0.074	Annual Reports	Ore $2.60 per ton
" 240-stamp mill, 1908–09	0.06	Annual Reports	Ore $23.9 per ton
" 300-stamp mill, 1908–09	0.08	Annual Reports	Ore $2.27 per ton
" 240-stamp mill, 1910–11	0.069	Annual Reports (12)	
" 300-stamp mill, 1910–11	0.082	Annual Reports (12)	
" Ready Bullion, 1910–11	0.077	Annual Reports (12)	
" 700-Foot, 1910–11	0.047	Annual Reports (12)	
Alaska Mexican, 1910–11	0.060	Annual Reports (12)	
CALIFORNIA:			
Mother Lode: Utica	0.076	W. J. L., R. H. R.	
Gover	0.13	T. A. R.	
Bunker Hill	0.30	L. J.	
Keystone	0.35	L. J.	
Grass Valley: Idaho	0.55	T. A. R.	
North Star	1.0	L. J.	
North Star, 1887–93	0.8	E. A.	
Empire	0.45	R. H. R.	Ore $5 to $30, catching 75%
Empire	1.0	L. J.	
W. Y. O. D.	0.55	R. H. R.	
Nevada county	0.40	(2)	Oxidized ore, 2 oz. per ton

	Oz. per ton	Authority	Character of ore
Plumas-Eureka	0.27	L. J.	
Taylor	1.45	L. J.	
Vandalia	0.57	L. J.	
Idlewild	0.08	R. H. R.	$4 to $5.50 per ton
Soulsby (single run)	0.058	(1)	High-grade free-milling quartz
Soulsby (single run)	0.083	(1)	
Average of small mills	0.5	E. B. P.	
Average of East Belt mines	0.5	E. B. P.	
Mills outside of Grass Valley (est. average)	0.2 to 0.67	J. H. H.	
	0.2 to 1.0	T. K. R.	
COLORADO:			
Gilpin county	0.18 to 0.4	T. A. R.	
Black Hawk	0.2	Collins	
Black Hawk	0.2 to 0.5	T. K. R.	12 to 20% pyrite
Liberty Bell	0.125	(3)	Crushing in cyanide solution
MONTANA:			
Montana Mining Co., Marysville	0.1	R. H. R.	Gold 0.2 to 0.4 oz., silver 2 to 4 oz. per ton
SOUTH DAKOTA (Homestake Belt):			
Caledonia mill (Monroe)	0.016	H. O. H.	Hard low-grade ore
Deadwood-Terra (Pocahontas)	0.035	T. A. R.	
Homestake mills, 1902	0.04	(4)	
Homestake mills, 1895	0.05 to 0.06	(5)	
Homestake mills	0.07	R. H. R.	
Homestake and Golden Star mills	0.055	T. A. R.	
Homestake and Golden Star mills	0.06	H. O. H.	
Homestake mills, average ore	0.132	C. & S.	
Homestake mills, low-grade	0.09	C. & S.	Oxidized; $1.93 amalgamated per ton
Homestake mills, higher grade	0.17	C. & S.	Unoxidized; $3.70 amalgamated per ton
NOVA SCOTIA: West Waverley	0.4 to 0.6	R. H. R.	$5 to $25 per ton, 95% saved
MEXICO: Chiapas	0.15	H.F.C. (10)	Very low-grade ore
VENEZUELA: El Callao	0.26	H. L.	$12 per ton
SOUTH AFRICA:			
Rand in 1903	0.076 to 0.212	(1)	Mostly feeding mercury to mortar
New Goch, 1903	0.075	(1)	
Ferreira Deep, 1903	0.15	(13)	Inside amalgamation, 65% amalgamated
Average of Rand in 1903	0.13	(1)	
Average of six large mills, 1907	0.13	(1)	
Best modern Rand practice, 1912	0.035	W. A. C.	Outside amalgamation only
ASIA:			
Palehleh, Celebes	0.3	S. J. T.	Outside amalgamation only
Palehleh, Celebes	0.75	S. J. T.	Inside and outside amalgamation
Oriental Consolidated, Korea:			
Average, 1912–13	0.07	(6)	
Average, 1913–14	0.08	(7)	$6.85 per ton; 50% amalgamated
Taracol, 1903	0.113	Annual Reports	$3.65 amalgamated per ton
Tabowie, 1903	0.076		$3.56 amalgamated per ton
Maibong, 1903	0.062		$3.55 amalgamated per ton
AUSTRALASIA:			
Clunes Field, Victoria	0.01	T. A. R.	Free-milling, blankets used, no outside copper plates; 3 oz. per ton
Ballarat	0.13 to 0.28	T. A. R.	
Ballarat	0.25	T. A. R.	Gold, 2 oz. per ton
Bendigo (New Chum)	0.38	T. A. R.	
Harrietville	1.0	T. A. R.	Double-discharge mortars; 5 oz. per ton
Brilliant United, Bendigo	0.14	T. A. R.	
Various Victoria mills	0.2 to 0.4	T. A. R.	
Kalgoorlie	0.2	H. J. B.	Dry-crushed, plates and pans; 40% recovery
Great Boulder, Kalgoorlie, 1913	0.133	(8)	
Otago, New Zealand	0.25 to 0.55	T. A. R.	
Otago, New Zealand, average	0.35	T. A. R.	

Manganese From Steel Slags

The importance of a judicious use of American steel-slags cannot be exaggerated. In 1917, owing to some interesting applications in Europe of certain steel-slags, an investigation of American slags was made by an American metallurgist to discover if any analogy existed. Six important slags regularly turned out by American steel companies are presented in this analysis. They all differ decidedly in their properties. Considering these slags from the standpoint of their value as manganese carriers, the following recapitulation is interesting:

Slag	Manganese oxide, %
Basic open-hearth	2.5 to 10.0
Acid open-hearth	3.0 to 21.0
Bessemer converter	5.0 to 22.0
Manganese steel from converters	45.0 to 50.0
Ferro-manganese furnace	5.0 to 12.0
Spiegeleisen furnace	2.5 to 5.0

When manganese ores became scarce, a good market was formed for the high-manganese slag from manganese-steel converters. This 45 to 50% manganese-dioxide slag has been sold to one or two companies making ferro-manganese. It has been used in their regular burden, and a large part of the manganese has been recovered, as well as some of the iron. Open-hearth and bessemer slags, particularly basic, are metallurgically available for use in regular blast-furnace charges, and economically so in many cases, but it is surprising how few pig-iron makers are availing themselves of this advantage. Basic slags are now being run through blast-furnaces to recover the lime and some of the iron, but particularly the manganese. One of the largest pig-iron and steel producers in the United States has in the past year or two raised the manganese content of the basic and other pig-iron from 0.90 to 1.50% by the use of basic slags alone. Some of the phosphorus is also given up, and when this becomes too high the charge of slag is discounted temporarily or for one day.

Slags, as a whole, represent by-products containing valuable ingredients. The basic slags in particular can easily be used, and it is believed that the successful employment of the acid slags can be advantageously accomplished. Bearing directly on these questions is the testimony of one large American steel and pig-iron maker, which is so explicit and illuminating that it is here quoted: "From our open-hearth slag we recover the metallic contents, iron 18%, plus phosphorus 1%, plus manganese 10.50%. This is equal to an ore value of approximately 25% in iron, figuring that we lose 40% manganese in furnace practice. This, of course, will vary according to temperature. Besides recovering the iron, we figure a limestone valuation of about 50%, that is, from every 100 lb. of open-hearth slag in use we get a credit in stone of 50 lb., or we might say that we take off 50 lb. of stone for every 100 lb. of open-hearth slag used. We figure that it costs the open-hearth department about $8 per car to waste the open-hearth slag which is saved by using it in the blast-furnace. In another furnace we use bessemer-converter slag, and recover the metallic contents, iron 8.50%, plus manganese 14%, or equivalent to iron ore of 16%. With converter slag we have a silica content of about 58%, which enables us to use a lower silica ore, consequently giving us a richer mix, and at the same time not too dry a burden, which reflects in the coke practice."

In Sweden two different procedures are being carried out for reducing, electrically, acid slags to alloys high in manganese. The first is the use to which slag from their bessemer converters is put. In Swedish practice pig-iron containing as high as 2% manganese is used, the manganese being the chief source of heat, because Swedish pig-iron is very low in silicon and phosphorus. As a result, a bessemer acid slag that is very high in manganese is obtained, sometimes reaching 50% MnO. Another Swedish slag comes from the blast-furnaces that make pig-iron. In producing an iron as high as 2% in manganese the slags have a very high manganese content also. Some are stated to average 20% in manganese oxide. Since the War started, and ferro-manganese and other manganese alloys for steel-making purposes grew scarcer in Sweden, attempts were made to recover the manganese. The Swedish bessemer slag is reduced with charcoal in an electric furnace, by which means a product is obtained containing about 60% manganese, with the balance made up largely of silicon and iron. From another source comes the information that the Swedish blast-furnace slags, which carry about 20% manganese oxide, are treated in an arc electric furnace requiring 1700 kw., and producing an alloy containing 60% manganese and 20% silicon. Because of the high silicon content the usual absorption of carbon is stated to be prevented so that it averages less than the usual 80% ferro-manganese. Reliable information is to the effect that the Germans are carrying out one or both of the electric-reduction methods for slags referred to, and using such alloys as substitutes for ferro-manganese.

A rough theoretical calculation shows a total slag output of about 2,373,500 tons in the United States in 1913, which contains approximately 148,376 tons of MnO, or 114,249 tons of manganese. It was much larger in 1916. The basic slag alone shows a manganese content of 86,159 tons of manganese, most of which is recoverable as manganese in the pig-iron. The acid slags, bessemer and open-hearth, contain 28,090 tons of manganese.

MOLYBDENUM was produced during 1917 from 17 different localities in Canada. The operations of the Canadian Wood Molybdenite Co., at Quyon, Quebec, was the most important. The ores were concentrated at the International Molybdenum Co.'s mill at Renfrew. The Canadian Wood company is building a second mill at Hull, Quebec, and a concentrator is being erected by the Renfrew Molybdenum Mines Co. at St. Patrick. Ferro-molybdenum is made at Orillia and Belleville, Ontario.

Operating Conditions at the Clarkdale Smelter

By L. S. AUSTIN

This smelter is owned by the United Verde Copper Co., operating at Jerome, Arizona. The plant consists of eight 21-ft. Wedge roasters, three blast-furnaces, two reverberatory furnaces, and five 12-ft. upright converters of the Great Falls type.

Six foremen are employed on the 8-hour day-shift, namely, one for the sampling-mill, one outside, and one for each of the operating departments. However, the sampling-mill is run by two shifts daily, needing a foreman for each shift, while at night the roasters are run without a foreman. This makes a total of 19 foremen daily to take charge of 250 men. Early in 1917 the labor cost was close to $1000 per day, or 40 cents per ton, while one man was needed for each nine tons of output; today all such expenses have greatly increased.

The blast-furnaces are 26 ft. 8 in. long by 44 in. wide at the tuyeres. In the middle of 1916, taking a whole month through, 635 tons was the daily output of each furnace; by the end of the year this amount was no better, being 580 tons per furnace. This figure is bound to vary according to the condition of the furnace and the charge. The furnaces are not shut-down for cleaning out, but are run down low, the crusts due to hot-top being burned out. Any adherent crusts are loosened by barring off. The difficulty, due to running a furnace with much over-fire, is that it overheats the furnace-top, the downtake and, in one instance at Anaconda, the dust-chamber and its contents were inflamed and damaged. With the Giroux hot-top this does not occur, since the large quantity of cold blast passing through the nested pipes in the closed top abstracts much heat, to say nothing of the aid furnished by the greatly heated blast in its action within the furnace. However, the crusts were burned off with so little difficulty that even barring down was seldom necessary. Variation in blast-furnace tonnage is due to variation in the physical condition of the charge. The total charge is made up of ore about 88%, with 6% each of limestone and of smelter cleanings or secondary material to be re-smelted. Per ton of charge, 6.5% of coke is used, and the furnace operates at 32-oz. air-pressure.

The blast-furnace charge is made up of (1) silicious ore, (2) iron ore, (3) converter ore, (4) oxidized ore, all new material, together with (5) limestone and (6) smelter cleanings, already mentioned. The silicious ore seems to be a misnomer, when we regard its composition. It contains Cu 5.2%; SiO_2, 22.0; Fe, 25.0; S, 21.0; Al_2O_3, 9.0; and CaO, 1.0%. It is thus named to contrast it with the iron ore containing Cu, 4.6%; SiO_2, 8.0; Fe, 36.0; S, 39.0; and Al_2O_3, 2.5%. Both these ores (1) and (2) are therefore sulphides. The converter ore (3) is really the proper silicious ore, containing with 2.5% of copper some 70% of silica. The oxidized ore is silicious, but low in copper, carrying Cu, 1%; SiO, 52; Fe, 21; and S, 2% only. These ores are combined in the charge in such proportions with limestone as to produce a slag of the following composition: Cu, 0.25%; SiO_2, 34; FeO, 45; Al_2O_3, 9; CaO, 4; and MgO, 2%; an iron slag low in lime. In the blast-furnace at least 75% of the sulphur is volatilized, leaving enough to form with the copper a matte of 18%, quite low for direct converting. It is, however, united in that operation with the reverberatory matte of 33% copper. There are eight men, including the foreman, per furnace-shift; one weigher weighing for the three furnaces.

The output of the seven 21-ft. Wedge roasters is 75 tons each daily, roasting down to 8.5% in the calcine. The raw charge, carrying 23% sulphur, averages 5.3% in copper. By calcining it loses 12% in weight. It is made up of silicious ore and iron ore, largely the former. One foreman and one helper per shift take care of the furnaces.

The two reverberatories, 19 by 100-ft. hearth-area, put through 350 tons daily. This consists of 210 tons of calcine, 70 of flue-dust, 10 of cleanings, and additions are made amounting to 70 tons more, for fettling. One notes the large amount of flue-dust from the blast-furnaces and some from the roasters, all of which can be successfully treated in the reverberatories. It can be imagined what difficulties would arise were there no reverberatory furnaces, and the poorer operation of the blast-furnaces were they compelled to re-smelt their own flue-dust. In such case briquetting would most likely have to be resorted to, with its resultant additional expense of $1 to $1.50 per ton for this operation alone. In this department, including the foreman, nine men are employed; this includes the motorman and brakeman who supply the furnace and remove the matte and slag. For the output of 350 tons daily there are used 325 barrels of oil, being 0.92 bbl. per ton of charge smelted. Allowing a credit of 110 bbl. for steam produced at the waste-heat boilers, there is left 0.61 bbl. of oil per ton of charge. It is generally reckoned that of the total heat developed, but 35% is effective in melting the charge. In the middle of 1916 the fuel consumption was greater, being 1.08 bbl. per ton of charge, from which should be deducted 0.31 bbl. for steam developed.

We now come to the 12-ft. basic-lined converters, all five in operation. About two tons of converter ore, containing 70% silica per ton of blister copper (also called bullion) is produced. Fourteen tons of copper is yielded daily per converter, using 28 tons of converter ore to

flux the iron oxide produced in the converting. The converter ore also yields some copper, since it carries 2% of that metal.

As regards temperatures, it is of interest to note that in November the air temperatures for the month ranged between 65° and 38°, the lowest recorded being 24° F. Of converter-air 37,000,000 cu. ft. daily, reckoned on the displacement, was used to produce the 70 tons of copper, being 530,000 cu. ft. of free air per ton. This was supplied to the converters at a pressure of 14 lb. per sq. in. The air, per ton of furnace-charge, may be computed at 100,000 cu. ft., or for each furnace 40,000 cu. ft. of free air per minute. This is on the displacement basis, with no allowance for slips and consequently for the actual quantity of air delivered. Slip may easily be reckoned at 15%, being no greater for higher pressure. The air, on its way to the furnace, passes through pipes set in the furnace-top above the feed-floor. The invention is called the Giroux hot-top. The air thus flowing through these pipes and to the bustle-pipe rises between 200 and 300° F. When a fresh charge is introduced the temperature is lowered, so that the blast-air drops to 225°, while just before the addition the furnace-charge is glowing, due to the fire creeping up; then the air in the pipes rises some 50° more.

Chrome Ores in Pennsylvania

The War has increased so greatly the demand for chrome steel for use in making armor plate, projectiles, and high-speed tools that between 1914 and 1916 the domestic production was multiplied almost eightyfold. From the beginning of the chrome industry until the Civil War the mines of chrome ore in Maryland and Pennsylvania were practically the only sources of supply for the entire world. Up to the latter part of the nineteenth century almost all these mines were owned or operated by the Tyson Mining Co. of Baltimore, Md. When the importation of Turkish ores lowered the prices of chrome ore in the market of the United States the production of these mines was reduced, and the Pennsylvanian deposits were relegated to the position of a reserve supply. Since the Eastern mines were closed, about 1882, the chrome ore produced in the United States has been derived almost entirely from deposits on the Pacific Coast, and the output has been declining, while the imports, chiefly from South Africa and New Caledonia, have been steadily rising.

In November 1917, E. F. Bliss, of the U. S. Geological Survey, examined the chrome-bearing rocks of the so-called State-line serpentine belt of southern Pennsylvania. Chromite is reported to occur at intervals along the northern boundary of the area of serpentine that extends eastward from Bald Friar, on Susquehanna river, through the southern part of Lancaster and Chester counties, Pa., and the northern part of Cecil county, Md. The ore is found as massive compact chromite in nodules and pockets of variable size in a serpentine gangue, and as a spotted ore in which grains of chromite are rather evenly distributed through the serpentine. The pockets that contain the massive ore are so irregularly distributed that prospecting is largely a matter of chance, but in view of the theory recently advanced that chromite is formed through segregation along the bottom or sides of an igneous intrusive mass, it is of practical significance to the prospector to note that most of the Pennsylvanian deposits lie along the north edge of an apparently southward-pitching mass of serpentine. Four of the old mines are on the contact of the serpentine and the crystalline schists.

Nine abandoned mines were examined. These extend from the old 'Line Pit', three miles east of Susquehanna river, on the Mason and Dixon line, for a distance of nine miles eastward. Four of the shafts, of which the deepest is at the Wood mine, long renowned as a collecting ground for rare minerals, disclose massive ore. Specimens from the Wood mine assay as high as 56% chromic oxide and average 48%. The remaining five mines show disseminated ore, known among the chrome miners of that region as 'birdseye.' In the prosperous days of the Eastern chrome industry this ore was apparently not considered sufficiently valuable to repay the cost of concentration. Now that the country is certain to be short of chrome ore the question whether low-grade ores can be profitably concentrated assumes new importance. At several old mines in Lancaster county and at three in Chester county there appears to be a fair grade of concentrating ore. At one mine about 2000 tons of disseminated ore is lying on the dumps, and rock taken a few feet below the surface about a mile east of the mine contains ore of the same character indicating a considerable quantity below the surface. Analyses of average samples from the dumps show 33.27 to 34.27% by weight of chromite in the ore. An analysis of the chromite concentrate from the samples shows 48.79% of iron and alumina and 51.21% of chromic oxide. The ore, which is non-magnetic, occurs in black grains of brilliant lustre. The gangue is a massive green serpentine that contains little or no asbestos.

In view of the geologic relations of the chromite deposits in this region and of the favorable market for the ore, the possibility of discovering and exploiting new deposits in southern Pennsylvania, as well as the practicability of working some of the old mine-dumps, should receive attention.

PORTLAND CEMENT specifications by the United States government established the following chemical limits, which shall not be exceeded:

	%
Loss on ignition	4.00
Insoluble residue	0.85
Sulphuric anhydride (SO_3)	2.00
Magnesia (MgO)	5.00

The specific gravity shall be not less than 3.10. and the residue on a standard 200-mesh sieve shall not exceed 22% by weight.



NEW YORK

Silver.—Rocky Mountain Club.—Coal.—Standard Oil.—Conscription of Wealth.—Publicity Copy.—Salt Production.

The silver situation is apparently more staple than has been supposed, and authorities both here and in Great Britain are satisfied with the present market price—about 92 cents per ounce. In the event of an unexpected appreciation in value the Government will probably take action by releasing part of the $200,000,000 worth of metal now stored in the Treasury in the form of silver currency, but the melting of this will be delayed as long as there is no immediate necessity for price regulation. Government price-fixing at $1 per ounce has been mooted, and leading silver producers are reported to be following the recent tactics of the farmers and storing their product in anticipation of a rise. Both China and India show enormous increases in exports during 1917, and a heavy demand from this quarter is expected in the near future.

The Rocky Mountain Club of New York numbers 1100 members, mostly mining men. Dues for town members are $50 per annum, while out-of-town members pay $25. The former are now urged to purchase $500 worth of Liberty Bonds when the new issue is open for subscription, and to hand them over to the Club in lieu of dues for 10 years. Other members are asked to buy $250 worth to cover their subscriptions for the same period. The interest accruing from the deposited bonds will go toward Club expenses and for patriotic purposes.

The Fuel Administration is apparently awakening to the fact that coal mined during the past winter was often of the poorest quality. There has been a concomitant of price-fixing as owners with the choice of several mines have, in many instances, concentrated their output from low quality and accessible deposits. Inferior coal has been responsible for much of the distress during the past winter, resulting in delay and congestion. Even the movement of army transports and naval vessels have been hampered on this account. Governmental action may now compel the mining of clean coal.

The Standard Oil group has distributed $26,483,747 in dividends during the current quarter. This exceeds any previous payment during a similar period subsequent to 1913 when the New Jersey company paid a special dividend of $40,000,000, bringing the total to $55,652,423.

The phrase 'conscription of wealth' sounds formidable and ultra-socialistic, but the application of the idea is well within the bounds of possibility. The Income Tax is really nothing more than a conscription of wealth, and a compulsory war loan would be more favorably received in that the money would only be lent to the Government. New Zealand, the cradle of many notable reforms and a school of practical sociology, has passed a law compelling subscription to war loans by those in a position to do so. The details of the scheme show that there would be little serious objection to its adoption in other countries. The New Zealand government compels those whose incomes for the year ended March 31, 1916, were not less than $3500 subscribe to war loans to an extent equivalent to three times their total amount of land and income tax (exclusive of excess profit duty) for which they are liable. The law further states that a taxpayer in this class who has already subscribed to an amount equal to 1½ times his tax liability, previous to the passage of the compulsory act, should be credited with that amount and his obligation reduced accordingly. This latter clause would indicate that those who had subscribed to a small extent only, and in disproportion to their income, would be obliged to subscribe the full legal maximum in addition to previous subscriptions.

Local opinion among journalists is almost unanimous in the opinion that the material emanating from the bureaus and committees at Washington, and disseminated broadcast by publicity agents, is almost valueless, and often duplicated to an extent suggesting an entire lack of co-ordination. It has been urged that real news-men should handle this work, that worthless copy should be eliminated, and the remainder submitted in a form permitting its publication without re-writing. At present a vast amount of time is spent in editorial offices in separating the occasional news item of value from the voluminous amount of valueless and ill-arranged copy that congests the mails and serves no useful purpose.

Total salt production in the United States during 1917 amounted to 6,946,000 short tons, an increase of 583,000 tons over the previous year. Of this total New York contributed 2,175,000 tons, a gain of 202,715 tons. This would have been greater but for labor troubles in certain districts. The State possesses exceptionally extensive rock-salt deposits distributed over 2000 square miles, mostly in Livingston county. They vary in thickness from 8 to over 300 ft. Ordinary coal or metal-mining methods are employed, and the product is broken and sized for the market. In some districts water is conveyed to the deposit through drill-holes, the brine pumped out and evaporated. Salt from solar evaporation is made in Onondaga county, but this method is being displaced by the use of vacuum-pan evaporation. Screened rock-salt is used extensively in the chemical industry, this accounting almost entirely for the large increase in production during recent years. It is a necessary product for the manufacture of caustic soda, sodium carbonate, sodium bi-carbonate, soda ash, salt cake, sodium chlorate, sodium acetate, sodium phosphate, chlorine, hydrochloric acid, and other compounds. The refined salt for domestic uses is made by cleansing the coarse crystals, re-dissolving, sterilizing, filtering in vacuum or pressure-filters, and re-evaporating. The final product is then ground, dried, and screened for shipment.

CRIPPLE CREEK, COLORADO

Ajax Deep Work.—Lost Shoot in Vindicator Found.—Rich Ore in Dante.—Lease Notes.

Ajax mine's February production totaled 1850 tons, valued at $37,000 gross. Since the Carolina company of Boston, operating under bond and lease, commenced operations, the shaft has been sunk from 1400 to 2000 ft. New orebodies have been opened at 1600 and 1800 ft., and prospects for ore on bottom level, where driving is in progress,

are considered good. Seven sets of sub-lessees are operating from above the 1200-ft. level, practically all working on ore. E. M. Rabb is superintendent

An important discovery for the Vindicator company has been made by Hayes & Co., lessees operating on the 1100-ft. level of the main shaft. The lost Martin ore-shoot on the middle vein of the Vindicator system has been found. It had jumped across the dike, so to speak. So far the shoot is 27 ft. wide by cross-cutting, and as broken the coarse ore will average better than $25 per ton. An initial shipment settled at $25.60 ptr ton, while screenings carry up to 4 oz. gold. Dr. A. I. Hayes, prominent physician of this district, and the head of the District Hospital, with his partner Craig, has spent over $5000 without return in search for the shoot, but now has one of the most profitable leases in the district.

In the Dante mine, on Bull hill, Fred Cobb has opened rich ore on the 600-ft. level. He is sub-leasing from the Big Toad Gold Mining & Milling Co., a lessee of the Dante Gold Mining Co. Cobb has opened a new shoot on the main Dante basalt vein, north. The core, a streak 2 to 6 in. wide of fluorite and quartz, shows calaverite assaying as high as 20 oz. gold per ton. The vein-matter is 4 ft. wide, worth nearly $30 per ton exclusive of the rich streak.

The Victory Gold Mining Co. will this week take over the Elmer Smith lease at the Howard shaft, also five leasing blocks of the Mary McKinney Mining Co.'s Gold Hill estate. E. P. Arthur Jr. will have charge of operations. Extensive development is planned and shipments will continue from ore already available.

An air-pipe line was laid last week from the plant at the El Paso Gold King mine in Poverty gulch to the Shoo Fly mine, on Womack hill, owned by Stratton Cripple Creek Mining & Development Co., operated under lease by Oscar Simms & Co. of Cripple Creek. Machine-drills are now in use, and shipments will follow.

Settlement made for the second car of ore from the shoot recently opened on 900-ft. level of the W. P. H. mine on Ironclad hill was at the rate of $50.40 per ton. The third shipment was loaded out last week. The property is owned by the United Gold Mines Co., and is operated under lease.

The Free Coinage Consolidated Mines Co. has commenced shipping from the Pinto mine of the Free Coinage Gold Mining Co. on Bull hill. Ore mined on the 450-ft. level, shipped to the Golden Cycle plant at Colorado Springs, is about 1-oz. grade.

Over 225,000 shares of Rose Nicol Gold Mining Co., believed owned by the estate of the late James F. Burns, were sold on the Colorado Springs Exchange last week. They realized 8¾ to 8¼c. The shares sold on March 14 at 15c., and on the 16th at 12c. in open market. The mine is under lease to the Camp Bird Mining, Leasing & Power Co. Ore has been cut at 800 ft. depth, also in the Roosevelt drainage-tunnel, cross-cutting the property at a depth of 2100 ft. Shares were selling about nine months ago at 4 cents.

The Dexter vein has been cut on the 800-ft. level of the Rose Nicol shaft, at a point 200 ft. south. The ore is 4 ft. between walls and will average $30 per ton. The property is under lease to the Camp Bird Mining, Leasing & Power Co. for six years, beginning 15 months ago. Plans for a large ore-house—enough for six cars—is to be constructed, and an aerial tram will be built to carry ore to the loading-station in Eclipse gulch. Ore has also been exposed by the Roosevelt drainage-tunnel in the Rose Nicol at a depth of 2000 ft. This vein is to be developed by drift from the tunnel-level. Ore will be taken out through the Elkton shaft, connecting with the tunnel.

The Howard shaft and five leasing blocks of the Mary McKinney Mining Co.'s estate on Gold hill was taken over last week by the Victory Gold Mining Co., represented by E. P. Arthur Jr. The lease was recently purchased from Elmer Smith of Cripple Creek, who had operated the mine continuously for 12 years past, and made a fortune. Smith ceased operating when one of his miners was killed in the mine about three months ago.

The Modoc Consolidated Mines Co. is raising from the 15th level of the old incline to connect with the new vertical Frankenberg shaft on the Modoc mine. Shipments will commence from the filled stope as soon as the connection is made. The incline workings will then be thrown open to lease.

The Clyde shaft of the Millasier Mines Corporation has been sunk to a depth of 1425 ft. The station at 1400-ft. level is now being timbered preparatory to development.

The Forest Queen Mines Co. has been incorporated to take over and operate the Gaylord lease on the Forest Queen mine on Ironclad hill. Officers and directors are Robert A. Sullivan, Denver, president; Edwin Gaylord, Cripple Creek, vice-president and general manager; and John H. Reddin, Denver, secretary and treasurer. The new company is producing steadily from two orebodies under development on the 650-ft. level. The Forest Queen is owned by Los Angeles and Southern people.

The estate of the late James F. Burns, founder of the Portland company, and for many years its president, has been valued officially at $1,251,871. The amount to be paid by the estate to the State as an inheritance tax will be $44,379. By the will the estate was divided equally between the widow and two children. John H. Nichols, superintendent for the Camp Bird Mining, Leasing & Power Co., has been elected a director of the Mary McKinney Mining Co., representing the Burns interests. Mr. Nichols will in September have charge of the mining interests of the Burns estate.

The Excelsior Mining, Leasing & Electric Co., lessee at the Longfellow claims of Stratton estate on Bull hill, has cut a vein 48 in. wide, 17 in. of which assays 3 oz. per ton. This is supposed to be Legal Tender vein of the Golden Cycle system.

ELY, NEVADA

Labor Troubles Settled; Cause of the Walk-Out.

Labor troubles of the Nevada Consolidated Copper Co have been settled for the time being. The men returned to work on the morning of the 26th. The Governor, Emmet D. Boyle, and State Labor Commissioner, Mr. Cole, came here and persuaded the men to resume work. The Governor has agreed to try to have Secretary Wilson of the Federal Labor Department at Washington, D. C., send a mediator, who will organize a State labor board to settle these questions during the War. The tie-up came about by firemen in the open-pit demanding a 50c. advance within 24 hours, or a walk-out. They went out, about 30 of them; not as a union, but independently. Then the enginemen and switchmen joined them, making 90 in all, thus throwing out of employment most of the company's men, between 2500 and 3000. The Ruth mine continued producing 3500 to 3850 tons daily from the underground workings. Of the thirty who went out first, not one had been on the company's payroll for six months. It is doubtful if there is a mining company in the United States which treats its men better. They are only charged $25 per month for board, room, light, and heat; the table alone costs the company $32.50 per month per man. There never has been a complaint against the board. The wage-scale of the class that went out is better than any other large copper company excepting at Bisbee, where they receive 10c. more per day. Condition of the roads has improved, and manganese shipments have been resumed.

TORONTO, ONTARIO

Improvements on Canadian Railroads.—Porcupine, Cobalt, and Other Districts.

The Canadian government is taking steps to put the main railroads in good condition. For some time renewals of rails have been badly needed, but have been postponed, owing to the difficulty in procuring them. The Government has placed a contract for 100,000 tons of 80-lb. steel rails with the Dominion Iron & Steel Co. of Sydney, Nova Scotia, to be delivered by the end of July. It has also secured 500 miles of light rails made in the United States for the Russian government. The heavy rails on some sidings and branch lines, and on the Hudson Bay railway now under construction, will be taken up, and lighter rails substituted. The heavy rails will be used for much needed replacements on the Government lines, and the Canadian Northern. The Canadian Pacific and Grand Trunk will be supplied with rails at cost, plus transportation charges. The rolling-stock of the Government roads, including the Canadian Northern, will be replenished by giving contracts for 150 locomotives and 7500 cars, tenders for which are now under consideration. The prices asked, however, are so high that, before letting the contracts, an investigation is being made to ascertain whether the details entering into the cost of manufacture justify the increase. Should the contemplated plans be fully carried out, the expenditure will approximate $40,000,000.

Cobalt.—La Rose Consolidated has prospects of a new lease of life, owing to an important discovery in the Violet mine. Here the shaft is down 425 ft. A cross-cut on the 410-ft. level cut three veins of good width and mineralization in the Keewatin zone immediately below the diabase. It is considered probable that this may be a continuation of the vein system that has yielded considerable silver in the O'Brien adjoining.

The new shares of the Adanac numbering 228,000 have been taken up by the shareholders at 10c. per share.

Fort Matachewan.—A road is being constructed from Elk lake to this new gold district. Supplies are going in to the Otisse property, where buildings are being erected. A small prospecting plant will be installed. The Craig property is also to be thoroughly explored. The district is likely to be the scene of much development as soon as the season permits.

Munro Township.—The Croesus mine and mill have been closed until after the War, owing to the high cost of operating. The mine has produced some rich ore, but expenses were considerably increased by flooding, and the management considers that loss of interest caused by the suspension will be more than offset by reduction in price of materials and labor later on.

Porcupine.—The labor situation is much better. There has lately been a considerable influx of men, as work is likely to be resumed soon on properties where operations were either suspended or much curtailed by reason of shortage of labor.

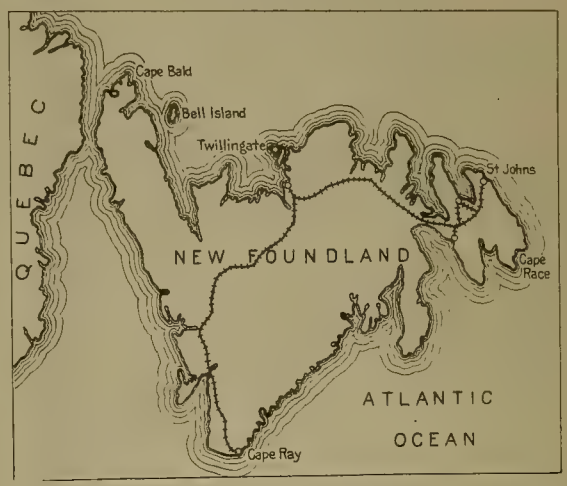
The Dome Mines Co. is developing an orebody 120 ft. wide, said to average $17 per ton on the 800-ft. level. Milling will not be resumed until enough of this grade is available to keep the plant busy. Under present conditions, it has been found impossible to treat $5 ore profitably. Sinking the main shaft to 1500 ft. is believed will open a large body of good milling ore.

At the Dome Lake mill an Oliver filter has increased capacity to 150 tons daily.

Most of the new equipment of the Hollinger mill has been tested and found to be satisfactory. Production is maintained, and resumption of dividends is likely at an early date.

ST. JOHNS, NEWFOUNDLAND

Twillingate.— The Great Northern Copper Co., operating chalcopyrite mines almost at the water's edge, has made arrangements for the erection of a small experimental mill and concentrator here. Results will decide definite plans for larger units to be erected later on. The company is said to have extensive ore-reserves and possess exceptional facilities for loading, and cheap transport to and from United States Atlantic ports, although this is restricted during the winter on account of the severity of the weather. The company also possesses the exceptional advantage of being outside autocratic dominance in flotation work by the Minerals Separation company. The milling tests will probably in-



MAP OF NEWFOUNDLAND

clude the use of sea-water and fish-oil. An abundance of the latter can be obtained cheaply, and the results of the tests should prove of general interest. The recent discovery of an oil-well at Bell island is an incentive to optimistic forecasts with regard to the fuel situation.

Fish-oils exported from this Dominion to the United States in 1917 and 1916 were as follows:

	1917		1916	
Kind	Quantity	Value	Quantity	Value
Cod, crude, gal..	1,837,652	$1,231,907	700,517	$493,640
Cod, liver, gal...	130,972	309,505	158,032	322,700
Seal, gal.....	358,088	403,066	574,171	474,447

The above figures will give an idea of the fish-oil available for flotation purposes, which could probably be increased if mining operations expanded.

VICTORIA, BRITISH COLUMBIA

Institute Meetings at Montreal; Probable Outcome of Discussion

Representative mining men of Canada gathered at Montreal, Quebec, from March 5 to 9. Several organizations held important meetings, the largest numerically being the Canadian Mining Institute. There were also sessions of two special bodies, namely, the Munitions Resources Commission and the Advisory Council of Scientific and Industrial Research, the latter acting in an advisory capacity to the Dominion government. W. Fleet Robertson, Provincial Mineralogist, was present at all of these meetings on behalf of British Columbia and, since his return, has had several conferences with the Hon. William Sloan, Minister of Mines. While he is not prepared to make any statement as yet as

to what was accomplished or decided upon, he asserts that policies were tentatively agreed upon which may be expected to lead to development of some of the rarer minerals of British Columbia for war purposes. At both the Research and Munitions Commissions there were in attendance representatives from the three other mineral-producing provinces of the Dominion—New Brunswick, Nova Scotia, and Ontario. That something may be expected in the more intensive exploitation of the resources of the Provinces, more especially in molybdenum and manganese, was intimated by Mr. Robertson. At the Canadian Mining Institute meeting one of the outstanding subjects considered was that of fuel production in Canada. In this connection the absolute dependence of Ontario on coal from the United States for domestic and industrial purposes was emphasized. It was felt that some action should be taken, and the decision was reached that the situation might be met by the development of the peat in the Province. That there was a large quantity of this fuel in Ontario, and that it might be produced in briquette or powder form in sufficient quantity to make the Province at least less dependent on importations was the concensus of opinion. An interesting paper was contributed by W. A. Carlyle, former British Columbian Mineralogist, later manager of the War Eagle mine, Rossland, B. C.; and more recently employed in Spain. It took the form of an illustrated talk on the Rio Tinto copper mines of Spain, where 15,000 men are employed and ore has been blocked out that is calculated to last more than a century. Members of the Institute visited the Armstrong-Whitworth Works at Longueuil, Quebec, to see the electric-steel furnaces in operation, making steel for high-explosive shells, also the higher grades of tool-steel. This is a manufacturing art which the same company has carried to great perfection in Great Britain. Mr. Robertson spent three days at Ottawa on his return, visiting the Dominion Geological and Mining Departments, also attending a special meeting of the Geographic Branch.

JUNEAU, ALASKA

Alaska Juneau Company's Mine and Mill.

F. W. Bradley, president of the Alaska Juneau Gold Mining Co., has issued the following statement to the shareholders, with the annual report:

The company's new mill has been in combined process of completion and operation since March 31, 1917, and the best it has so far been made to accomplish is less than one-half of its promised capacity, at an operating cost per ton of over twice the expected cost. By installing machinery for an additional stage of crushing, the capacity of the mill can be increased, and by making other costly additions to and changes in the mill it would be possible to reduce the present high operating costs; but the real problem has been to keep as much waste as possible out of the fine-grinding end of the mill-work. It is estimated that two-thirds of the feed to the mill has been straight waste, and that the cost of fine grinding it is greater than the cost of fine-grinding ore.

The new mill was designed with the plan in view of both 'wholesale' mining and 'wholesale' milling; but as the lay-out of the pre-mining work has resulted in a caved mixture of an undue proportion of waste with ore, the wholesale plan of milling what has turned out to be (as far as the original pre-mining caving system is concerned) an uncontrolled mixture of waste and ore has had to be abandoned as unprofitable. Therefore in order to operate at a profit, the mine and mill operations are being re-adjusted to the 'sorting' plan of working which was interrupted nearly three years ago when the 'wholesale' plan was decided upon.

The payable values in the vein are carried by quartz stringers that, as so far developed in the Alaska Juneau property, have averaged about $6 in gold per ton, in addition to their lead and silver values, and are susceptible of being partly sorted out from their enclosing vein-matter. This is not only because of the marked difference in color between the quartz and vein-matter, but because the quartz is much more friable than the vein-matter and thus lends itself to a partial mechanical separation, both when mined and when subjected to coarse crushing in the mill. Monthly crushings of several thousand tons each during the 16 years' operation of the old 30-stamp mill have given free-gold yields varying from a minimum of 35c. for low-grade vein-matter up to a maximum of $6.21 for sorted-out quartz. In addition to its recoverable gold, the ore also carries recoverable lead and silver values. Many milling-tests in the old 30-stamp mill on ore sorted from the surface workings in the vein, and also milling tests in the pilot mill on ore sorted from the deepest workings in the vein have given recoveries of over $5 free gold per ton from all the ore so sorted. During the first six months of 1915, 23,286 tons of mixed sorted quartz and vein-matter made an average mill-feed for the pilot mill of $3.22 gold assay-value per ton. The sorted ore thus milled was obtained by mining three tons of vein-matter, of which two tons were left in the stopes as waste-filling and the remaining ton of about equal portions of sorted quartz and vein-matter was sent out of the mine as mill-feed. Because the pre-mining system as carried out has left no control over the quantity of waste mixed with ore, the mill-feed for the new mill during 1917 has averaged a gold assay-value of 87.5c., or 3.74c. less than the gold assay-value of the mill-feed to the pilot mill for the year 1916. This lack of control has resulted in sending such a large proportion of waste with ore to the mill that of the rock over 12 inches in size fed to the mill, probably 90% has been straight waste, as distinguished from low-grade vein-matter.

To overcome this waste dilution and thus place the property on a profit-earning basis, an installation is being made, as outlined in the accompanying report of the general superintendent, to mechanically reject as much coarse waste as possible between the Blake and gyratory crushers. Also a new stope is being opened on another section of the vein where physical conditions promise a dilution of less waste with the ore and consequently a higher grade of feed for the mill. Up to March 10 this new stope had been cut out in vein-matter for an area of 25,482 sq. ft., with an average gold assay-value for that area of $1.56 per ton.

SILVERTON, COLORADO

Recent Activities in the District.

The Sunnyside tram is almost complete and the new mill is ready to begin the season's run. It is expected to produce over 1000 tons of concentrate per month. It is probable that this mine will be rated as one of the largest, if not the largest, producers in the district. The mine is under the management of M. M. Kuryla. The company has been making conditions agreeable for employees, in the matter of recreation and welfare work, and all seem to be satisfied. Labor shortage is not expected during the coming season.

The D. L. & W. Mining & Reduction Co., managed by H. M. Kingsley, and financed by Iowa capital, is now working at full capacity, employing over 20 men. A tram has been built over a distance of 3000 ft., leading to a siding on the Silverton Northern line, thus saving packing ore down the mountain-side. A mill will probably be erected by the company along the Animas river. The company's future appears to be good. The Crater mine, above Animas Forks, is another property that will be operated by this company during 1918.



ALASKA

Fairbanks.—Eighteen miles east of this place is the Stepovitch tungsten mine. In 'Economic Geology' for March the property is briefly described by Alan M. Bateman. The deposit occurs within Birch Creek schists, which consist of crystalline limestone and mica-schist. Ore appears to be a replacement and impregnation of the limestone along its contact with the mica-schist. It occurs as small shoots within the limestone. One shoot is 4 to 60 in. wide, the other 12 to 72 in. wide. Operations have been of a haphazard nature. Depth opened is 50 ft. on incline. One shipment of 265 tons has been made.

ARIZONA

Globe.—Old Dominion company last week exploded 25 tons of Hercules dynamite, breaking 300,000 tons of limestone. This is used as flux in smelting. W. G. McBride, general manager, states that this was the second largest blast ever set off in Arizona, one at Ray being bigger. In the news last week we mentioned a large blast at Ajo, whereby 200,000 tons of ore was broken.

Jerome.—General Development Co. has suspended work at Jerome Copper Co.'s property after doing 1750 ft. of work. Resumption is dependent, it is said, upon developments in the Green Monster.

Mammoth.—W. R. Ramsdell and associates have purchased the molybdenite property of E. W. Childs at Copper Creek. A large body of molybdenite is blocked out, containing 2% MoS_2. This property has been held by various interests, but because of small copper content has been given up. It is claimed that metallurgical difficulties are now overcome.

Mayer.—Consolidated Arizona company's Blue Bell mine has opened two new orebodies, one on 800-ft. and the other on 1200-ft. level. The latter level will soon be yielding 150 tons daily. A drift on 800-ft. level is to be driven south to open the Blue Thunder shoot 2200 ft. from main shaft.

Metcalf.—Shannon Copper Co. may curtail operations on account of decrease in value of ore. At Clifton, the company will continue to concentrate and leach 15 tons of ore daily, extracting 14 to 16 lb. of copper per ton at cost of 12c. per pound. N. L. Amster is president.

Miami.—Miami Copper Co. is reported as preparing plans for increasing capacity of its 6000-ton mill.

Tombstone.—Bunker Hill silver mine, owned by Phelps-Dodge Corporation, was closed last week on account of low grade of ore. Manganese has been mined during the past 6 months. Lessees will continue to work.

Tucson.—No. 2 shaft being sunk by San Xavier Extension has cut some ore that was found on 275-ft. level of prospecting shaft 150 ft. north.

Alpha Copper Co.'s work on 200-ft. level proved that two outcropping veins have junctioned into one body 25 ft. wide of high-grade lead-silver-copper ore.

Reiniger-Freeman company, operating in San Xavier district, has found a new silver-gold vein in main shaft, which is 208 ft. deep. Work has been started on San Carlos claims of this company.

CALIFORNIA

Alleghany.—Second trial of the suit of Senator William Flinn of Pittsburgh, Pennsylvania, against the Twenty-One Mining Co. is being held before Judge Thomas F. Graham in San Francisco. In 1913 Flinn agreed to purchase the mine for $250,000. He paid down $25,000. When he started to work the mine he alleged that the ore was not equal in value to samples and that the mine had been salted. Judge Graham gave him a judgment. Soon after the Twenty-One company resumed possession of the mine the company extracted gold worth $125,000, having found a shoot. Then the Twenty-One asked for a new trial, holding that Flinn's contention that the mine had been salted was not justified. This question is to be decided by Judge Graham. Further complications entered the case when the Supreme Court gave a decision recently, holding that the Sixteen-to-One mine is entitled to the high-grade ore mined by the Twenty-One company on the ground that this ore was taken from the Sixteen-to-One.

Crescent Mills.—Juneday Mining & Milling Co., operating at this place in Plumas county, has put up a good deal of machinery, expects to construct a power-line this spring, and will erect a 50-ton mill during the summer.

Downieville.—To impound debris from hydraulic mines at Brandy City, a concrete dam is to be constructed across the North Yuba river at Bullard's Bar. G. E. Taylor is manager.

Forest.—Kate Hardy Mining Co. has received permission from State Corporation Commission to issue, in addition to directors' qualifying shares, 250,000 shares to the San Jose Realty Co. in consideration for a lease and an option to purchase the property. The company is also authorized to sell 250,000 shares at 25c. per share, so as to net 80% of the selling price.

Kennett.—Wage dispute at the Kennett smelter, between the Mammoth Copper Co. and its 300 blacksmiths, smeltermen, electricians, zinc-plant workers, and machinists was to be adjusted in San Francisco on March 30 by the Federal Wage Commission. Company and men have agreed to abide by the Commission's ruling. The tradesmen urged that they should receive the same pay as men similarly employed in shipyards around San Francisco, but the company holds that it cannot afford to pay such wages.

Needles.—Rincon Mining & Milling Co., having claims in the Monumental mining district of San Bernardino county, has been given authority by the State Corporation Commission to issue 1250 shares to Walter J. Farr, H. W. McDowell, and J. C. McDowell in exchange for four groups of claims on the Colorado river, together with machinery, improvements, and equipment thereon. Company is also authorized to sell 250 shares at $50 per share for cash, so as to net the full selling price.

Silver Lake.—Wanderer Mining Co., with 13 claims in San Bernardino county, has received permission from the

State Corporation Commission to sell 4950 shares at 20c. per share, and 60,000 shares at 60c., so as to net 80% of the selling price. All of the claims have been worked previously. The company proposes to re-open the lower adit.

COLORADO

Boulder.—Metal Mining Association's annual dinner here recently was largely attended. The Association is considered to be doing good work.

James Duce, State Oil Inspector, is to make an examination of petroleum resources of Boulder county.

Lucky Two mines, between middle and north Boulder creeks, has been acquired from the W. B. Holmes estate by W. F. Bleecher of Boulder. Property is a large producer, and is to be extensively developed.

Nederland.—La Plaisance M. & M. Co. has been incorporated by E. V. Grant, F. A. Fair, and Alfred Dawson to operate the La Plaisance with the New England mine. Former was a large producer of gold and silver years ago. Machinery is to be ordered.

Ouray.—Silver Point Mines Co. has been organized with capital of $50,000. A. E. Bundson of Denver is president. Mine was a good producer of silver ore about 15 years ago. It is just south of Bear creek. The lower adit is being reopened.

Prospectors are preparing for exploration of the Cow Creek district, following discovery of molybdenite there last fall.

Rico.—Rico Argentine company last week had 1000 tons of lead and lead-zinc ores awaiting improvement in roads.

IDAHO

Kellogg.—J. P. Acoam of Spokane and associates have concluded purchase for $80,000 of controlling interest in property of Sidney Mining Co. in Pine Creek district. The property includes 18 claims, covering 350 acres.

Mullan.—Federal Mining & Smelting Co., during quarter ended January 31, made a loss of $193,525, compared with a profit of $359,929 in the previous period. Shipments included 12,036 tons of ore and concentrate, against 32,659 tons.

Copper King has opened ore 50 ft. wide for a distance of 75 ft. Ten feet on hanging wall assays 3.3% copper and 17 oz. silver per ton. Remainder assays 4 to 6% lead and 5 oz. silver. Ore is in Revett quartzite. A 200-ton mill is proposed later on. H. W. Ingalls is manager.

Paris.—Western Phosphate M. & Mfg. Co. is to erect a 100-ton plant to crush phosphate rock. Deposit is said to be 150 ft. wide, with two strata, 6 and 10 ft. thick, carrying 73 to 78% tri-calcium phosphate. The crushed rock is applied directly to soil as a fertilizer. Lewis A. Jeffs, of Salt Lake City, is general manager. Shipments to Pacific Coast points have been maintained since October last.

Sagle.—Armstead Mines Co., operating on Pend Oreille lake, H. H. Armstead president, has secured $200,000 for erection of development and 100-ton mill. O. B. Hofstrand of Salt Lake City has designed the plant. Ore carries silver mostly, with some gold and copper.

Wallace.—Coeur d'Alene region in 1917 produced the following metals, according to Robert N. Bell, State Mine Inspector:

Lead, pounds	395,883,000
Zinc, pounds	96,123,000
Silver, ounces	12,497,917
Copper, pounds	7,282,000
Gold, ounces	41,326

Wardner.—Lookout Mountain M. & M. Co. has been financed by M. Baumgartner of Spokane. About $10,000 is to be spent on compressor, machine-drills, and extending the adit. Property is on Pine creek. Ore carries lead and silver.

KANSAS

Baxter Springs.—Inspiration company, 7 miles west, is operating its 400-ton mill 10 hours daily. Ore carries 7% blende, and concentrate 50% zinc and 50% lead. Shafts are 250 ft. deep. B. E. Brown is general superintendent for the controller, Fred Hutting.

MICHIGAN

Houghton.—Ahmeek Mining Co. pays $2 per share on April 10. Mine is producing 5000 tons of ore daily.

Osceola Consolidated pays $2 per share on April 30. This makes $4 for current year.

Seneca Copper Co.'s shaft has cut the Osceola lode. Some of the ore carries rich 'shot' copper. Lode is in two parts, hanging-wall side being 9 ft. wide.

Mohawk is to use four electric locomotives in No. 6 shaft, if they can be secured.

Coal docks of Calumet & Hecla have been burning for over two weeks. More than 100,000 tons of coal is stored there.

Mayflower-Old Colony Copper Co.'s initial report for 8 months ended December 31, 1917, show balance of cash assets amounting to $32,302, against $103,596 on May 1. Main shaft is 261 ft. deep. Sinking by bucket is to be superseded by skip.

Indiana company has suspended work indefinitely due to lack of funds. Little has been done for some time.

Mass Consolidated Mining Co. in 1917 crushed 244,671 tons of ore averaging 16.29 lb. per ton, yielding a total of 3,984,616 lb. In 1916 the figures were 287,900 tons, 16.51 lb., and 4,752,588 lb., respectively.

Iron Mountain.—Aragon mine, one of the Oliver properties, situated at Norway, will be electrically operated as far as possible. Plant will include pumps, underground haulage, hoisting, etc., and is on the way. Power will come from hydro-electric plant at Quinnesec Falls.

At Traders mine of Antoine Ore Co. new electric machinery, including two pumps and compressor, are being installed. Electric haulage was started last fall. Compressor capacity is 1200 cu. ft. Pumps will handle 600 gal. per minute each. Normal inflow is 200 gallons.

MISSOURI

Damsel.—Osage Mining Co.'s property in Camden county was examined in October last by F. E. Small, the following being abstracted therefrom: Deepest shaft is down 75 ft. Several others have been sunk, also several adits driven. All openings are said to show ore carrying lead, gold, silver, copper, and zinc. Drill-holes from 70 to 200 ft. deep also show ore. Production so far has been 500,000 lb. of lead ore. A 1000-ft. shaft is suggested to follow one of the drill-holes. Cost of mining and milling is estimated at $1.50 per ton.

Galena.—Drill-hole put down by L. H. Phillips of Joplin on leased land shows the following record:

Depth, ft.	Blende, %
230 to 235	9.68
235 to 240	7.60
240 to 245	23.98
245 to 250	10.43
250 to 252½	11.17
252½ to 255	17.00
255 to 260	19.81
260 to 267½	30.10
267½ to 272½	57.81
272½ to 275	26.82
275 to 280	5.36

Joplin.—Zinc-ore market was weaker last week. Production of Missouri-Oklahoma-Kansas region was 9577 tons blende, 175 tons calamine, and 1697 tons lead, averaging $48, $35, and $85 per ton, respectively. Total value was $513,231, making $5,750,308 for 12 weeks. Oklahoma contributed $444,349 of last week's total.

MONTANA

Butte.—Davis-Daly Copper Co. reports as follows for last quarter of 1917:

Development, feet	1,934
Ore shipped, tons	11,891
Copper, pounds	1,773,701
Silver, ounces	76,498
Revenue	$364,392
Disbursements	219,919

Cash at end of year amounted to $105,048, and quick assets $129,812.

Tuolumne Copper Mining Co. during 1917 shipped 30,972 tons of ore, averaging 2.431% copper, 1.471 oz. silver, and 0.0072 oz. gold per ton. This was mined on 1200, 1400, and 2600-ft. levels. On account of high costs, operations at the Tuolumne mine were suspended at beginning of 1918. Net smelter return was $200,303. Main Range mine produced 10,967 tons, assaying 1.972% copper, 9.422 oz. silver, and 0.0078 oz. gold. This came from 700 stope on Spread Delight vein. Shaft is being sunk to 800 ft. Net smelter return was $106,703. At Colusa-Leonard Extension mine development is under way at 1600 ft. New machinery was installed. Main Range company will soon be directly controlled by Tuolumne. Paul A. Gow is manager of all properties.

Helena.—Thomas Cruse Developing Co. has installed a new air-operated hoist on the 640-ft. level. A winze is being sunk on vein which carries good gold-silver-lead ore.

A 75-ton concentrating mill is being built at the Economy mine, East Helena. About 125,000 ft. of lumber will be required. The mine is developed 300 ft. deep.

Iron Mountain.—Intermountain Copper company shipped 2 cars of ore and 8 cars of concentrate during March. Crude ore averaged $1200 net per car, and concentrate $2200. Recent development revealed 30,000 tons of ore between 200 and 400-ft. levels, east of two faults. In the plant a ball-mill and Wilfley table have been added, raising capacity to 125 tons daily.

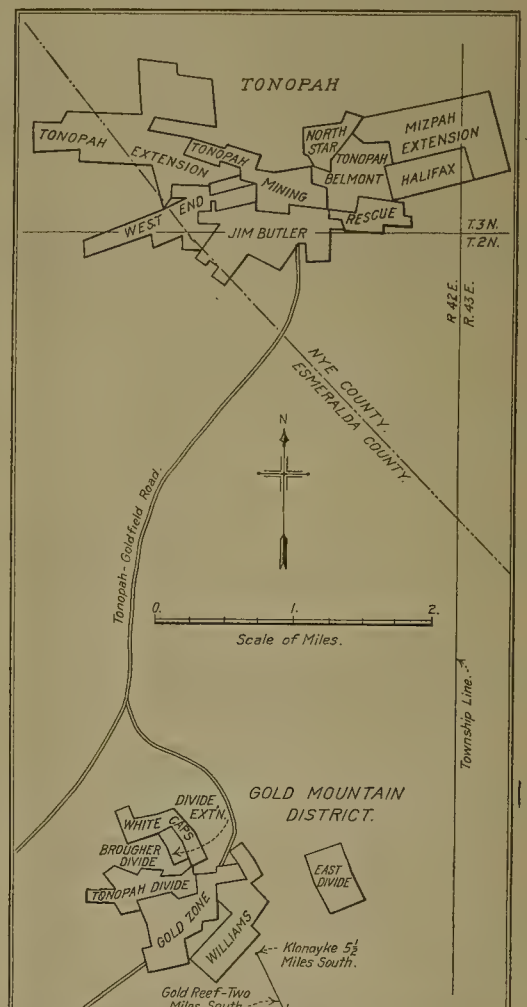
NEVADA

Aurum.—Spring Valley Copper Mines Co. has been organized by G. E. Hemphill and others of Utah to operate in the Muncy district. Good copper-silver and silver-lead-copper ore has been opened.

Goodsprings.—Yellow Pine Mining Co. reports for January 1956 tons of concentrate and ore returned $57,579 gross. Expenditure was $16,804, leaving $40,774 profit. Mill was closed at end of month. In February, 1475 tons of crude zinc-lead, 115 tons of zinc, and 50 tons of lead ore was shipped; but no returns are available yet. A new crushing and sorting plant was installed for crude ore. The 700 north orebody yields most of the ore, but new shoot on 300 sub-level is becoming important.

Omco.—Olympic Mines Co. in two years has transformed this place from a sage-brush patch into a thriving little centre with post-office and daily mail service. Omco is 25 miles north-east of Mina, in Mineral county, the nearest rail point. The 100-ton mill and cyanide plant has just completed a satisfactory year's run. During this period ore averaged $18 gold per ton. Extraction was 96 to 97%. Machinery includes a Joshua Hendy ball and tube-mill, Dorr duplex classifier, thickeners, and agitators, Oliver filters, and Merrill apparatus for zinc-dust precipitation. On March 19, the Governor, ex-Governor, and other prominent Nevadans visited the property. The men were addressed concerning their position as Americans in the present strife. A branch of the Red Cross has been established at Omco. Every member of the community is identified with the movement, and most of the men contribute one day's pay per month. Fred J. Siebert is general manager and J. O. Greenan superintendent.

Pioche.—In the suit between Virginia-Louise and Prince Consolidated, in which the former was awarded $27,334,



MAP SHOWING SITUATION OF GOLD MOUNTAIN DISTRICT, NEVADA

and costs about $3000, the plaintiff could not collect, as the defendant also had an apex suit against Virginia-Louise, which was not settled. Virginia-Louise retaliated by asking the Nevada Railroad Commission to declare the railroad of the Prince company a common carrier and force it to carry Louise ores. The dispute has been settled, judgment against the Prince is canceled, and the apex suit and the common carrier case are to be dropped. The Prince has agreed to haul the Virginia-Louise ores over its railroad. The transportation agreement covers a period of five years.

Tonopah.—Ore production of district last week was 10,972 tons, valued at $183,464.

Tonopah Extension in February extracted 835 oz. gold

and 82,882 oz. silver from 7927 tons of ore, realizing a profit of $16,584.

Apex suit between Jim Butler and West End was argued before U. S. Supreme Court at Washington on March 27. No decision is expected before June.

Interest increases in the Gold Mountain district, and development expands. The Tonopah & Goldfield Railroad may construct a spur from its main line into the district. Tonopah Divide shares have sagged from $2 to $1.75. Last week the drift on the 270-foot level was advanced 47 feet in good ore. A compressor and hoist are being installed. ——Tonopah Gold Zone Mining Co. has been re-organized as Gold Zone Divide Mining Co. Old 300-ft. shaft is to be repaired.——Divide Extension has been provided with a hoist and compressor. So has the Dividend mine, where sinking is in progress.——In the Gold Reef district, near Gold Mountain, the Gold Wedge property is said to be a good prospect.

NEW MEXICO

Hanover.—Republic Mining & Milling Co. is shipping high-grade zinc ore to smelters in Pennsylvania. Report for period October 1, 1916, to January 1, 1918, shows that receipts totaled $41,467, of which $31,748 was from sale of shares, $9000 from notes payable, and $719 from iron and lead ore. Equipment and development cost $29,438, and purchase of property $5500. Estimates of developed ore in both groups total 75,000 tons, assaying 19% zinc. To depth of 200 ft. there was 970 ft. of work done by the present owners. When 100,000 tons are opened, a 100-ton mill is to be built.

OKLAHOMA

Commerce.—Consolidated Zinc & Smelting Co. has acquired the Emma Gordon and other tracts here. Some of them are well developed, with mills in operation. J. D. Hawthorne is superintendent.

Picher.—Production of the region last week was 7254 tons blende and 1129 tons lead, valued at $444,349.

Big Chief Mining Co.'s property—40 acres and 250-ton mill—was sold last week for $150,000 to Oklahoma City and Wayne people, represented by J. M. Curtis.

Quapaw.—Imperial Development, St. Louis Lead & Zinc, Big Three, and Muskogee Lead & Zinc companies have combined to fight the water problem. A 10-in. Texas pump is to be put in the Muskogee, just east of Imperial, which already has two 12-in. and one 14-in. Pomona pumps, and another Texas pump. Water was encountered at 167 ft. in the Imperial. Shaft was cemented and 200 ft. was attained, but driving could not be done on account of water. Rich ore was opened during this work. J. C. Isbell is manager and G. O. Spafford superintendent.

Tar River.—Standard Lead & Zinc Co. has sold its property and 250-ton mill to Fort Worth, Texas, people, for $250,000. J. D. Young and others are interested.

OREGON

Grants Pass.—Mountain Lion gold mine, 12 miles southwest of Grants Pass, has been acquired by J. P. Sinnott of Portland and C. G. Murphy of Grants Pass. They have erected a 30-ton Lane mill. This mine has been extensively opened during the past 25 years, there being 8000 ft. of workings done on two veins that are in greenstone and slate, and close to contact of these rocks within an area of granodiorite. The slate occurs as narrow lenses in the greenstone and the best ore of the veins has been obtained near the contact of the two rocks. The veins are 12 in. wide and are faulted at many places. The vein filling consists chiefly of quartz, calcite, and sulphides, the last constituting 1%. The new equipment is driven by gasoline power.

Takilma.—Golconda chrome mine, six miles north-east of Takilma, has made an initial shipment of two cars of ore at Water creek under the new lessee, R. J. Rowen. Thirty-five miners are employed, and on arrival full equipment of auto-trucks ordered, production will be 1200 tons of ore per month.

TENNESSEE

Manganese deposits of Bradley county are briefly described in 'Resources of Tennessee' by the late A. H. Purdue, State Geologist. In 1916 a new deposit was opened 9 miles south of Cleveland, and another in 1917, two miles away. Manganese occurs in limestone and residual soil above it. Layers of the mineral vary up to 14 in. thick. Ore is said to be high grade, and is found in caverns in the lime and in the clay. Some boulders weigh 800 lb. Present operators expect to get one ton of manganese from each 100 tons of residual material. Immediate source of the mineral is Tellico sandstone.

TEXAS

Abilene.—Rich copper ore has been discovered on ranch of James Bilberry, near here. For several hundred feet the deposit is 7 ft. thick. Native copper is found scattered over a wide area north and east of Abilene, and geologists think that it has come from this deposit. C. S. Brown of Post and L. A. Harrison of Jayton, Texas, have obtained a lease on the property and are preparing to begin extensive development.

Damond Mound.—Texas Exploration Co., holding 5200 acres near here, is to construct a large sulphur plant, using the Frasch process of extraction from the beds. E. F. Sills, H. T. Staiti, and George Hamman of Houston are largely interested.

Quanah.—T. Sanford Gibbs will erect a mill at his copper mine situated near this place.

UTAH

Alta.—Cardiff Mining Co. has 12 ft. of $159 ore on 800-ft. level. It carries 9.1% copper, 26.6% lead, and 117.4 oz. silver per ton, also desirable quantities of iron. About 250 tons has already been broken. Bins at mouth of south fork are full of ore, also on dumps, totaling 3000 tons. This is valued at $40 per ton. When roads permit, over 200 tons daily will be shipped.

Bingham.—Bingham Mines Co. paid 50c. per share on April 1. This is equal to $75,000, making $337,500 to date. Net receipts of company's properties during past two years were as under:

Mine	1917	1916
Dalton & Lark	$174,501	$132,537
Commercial	1,758	1,461
Victoria	2,755	.....
Victoria Con.	146,753	37,893
Eagle & Blue Bell	498,677	136,126

Yosemite showed a loss of $12,918, against a loss of $5646 in 1916.

Park City.—Silver King Consolidated Mining Co. reports the following for 11 months of 1917 compared with the whole of 1916:

	1917	1916
Ore, tons	10,260	10,082
Gold, ounces	403	423
Silver, ounces	451,627	439,007
Copper, pounds	248,771	288,819
Lead, pounds	5,016,627	5,273,216
Net smelter returns	$642,467	$500,498
Dividends	383,287	294,561

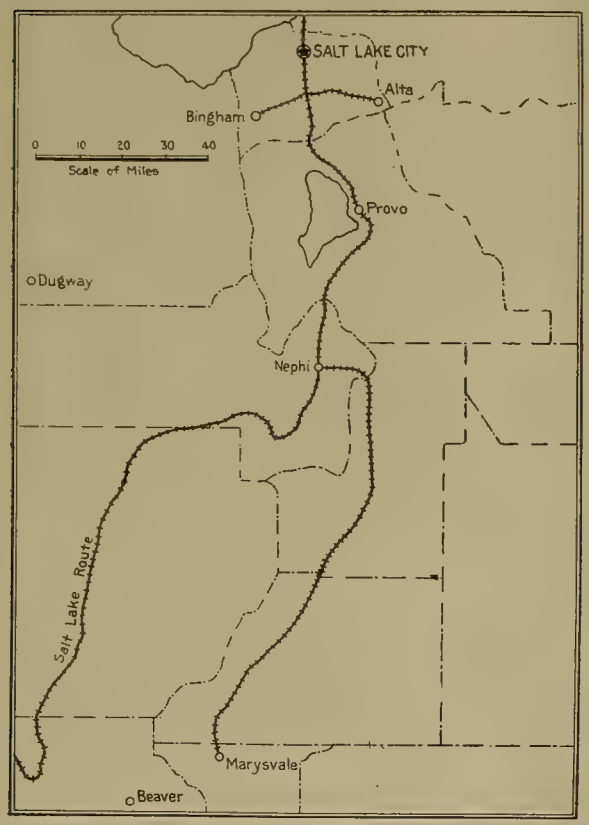
The Spiro adit is in over 5000 ft., the last 2300 ft. being

in Woodside shale, after which favorable ore-bearing formation is expected. Solon Spiro is general manager.

Dugway.—According to Israel Larson, superintendent for the Lucky Star Copper Mining Co., in the Deep Creek district, rich copper ore has been opened at a depth of 100 ft. This shoot has widened to 5 ft. and appears to be dipping toward the orebody on the 220-ft. level. Ore is being sorted preparatory to sending it to the smelter.

At a depth of 190 ft. in the Silver Bell mine, from 5 to 7 ft. of 7% copper ore has been opened. Some rich ore occurs in small pockets.

Marysvale.—Mineral Products Co.'s new mill is treating 200 tons of alunite daily, producing 20 tons of potash. This



PART OF UTAH, SHOWING SITUATION OF MARYSVALE DISTRICT

replaces the plant burned in October last. An immense quantity of ore was blocked out during suspension of treatment.

Florence Mining Co.'s alunite mine adjoining will have a 100-ton plant operating by June. Jacob Young is in charge.

In the Iron Cap mine, 6 miles from Marysvale, a mixture of alunite and iron ore is being opened.

Copper, gold, and silver ores are being mined in the district.

WASHINGTON

Keller.—Lack of transportation facilities has hindered development and production from this region, but hopes are held that a railway may be built.

Iron Creek mine is the most developed property in the district. Ore contains copper and silver. A 25-ton mill is contemplated.

Illinois Copper & Mining Co., three miles west, has opened a wide vein carrying gold, copper, silver, and zinc.

Great Northern Mining Co., 15 miles from Keller, has done 1850 ft. of tunneling and opened a wide copper-gold vein.

Addison Copper & Milling Co., 7 miles east, has developed lead-silver ore.

Walla Walla Copper Mining Co. has sunk two shafts, is sinking another, and drove four adits a total of 1200 ft. Manager, J. E. Leonard, states that copper ore is to be shipped soon.

Manila Mining & Milling Co., four miles west, has been extensively developed, and is said to have a large quantity of ore in reserve.

Spokane.—While this city has for years been the recognized mining centre of the North-West, it is only recently that a mine has been developed within the limits of Spokane county. After a short period of development, high-grade native silver and galena ore has been opened by the Silver Bell Mining Co. near Loon Lake.

Walla Walla.—Niaga Placer Co. has been formed with capital of $500,000, $282,000 issued with shares at $1 per. Trustees are M. Zuger of Waitsburg, A. M. Elam of Milton, W. B. Brooke, Ernest Knight, John Rosendahl, and Hugo Reinman, all of Walla Walla, and C. B. Brooke, of Seattle.

CANADA

British Columbia

Hedley.—Hedley Gold Mining Co. paid its quarterly dididend of 30c. per share on March 30. The sum was $36,000, making $2,339,520 to date. The last disbursement was a reduction of 20c. per share, 50c. having been paid for a considerable time.

Prince of Wales Island.—Complex mine of J. L. Harper, formerly of Republic, Washington, is supplying rich lead-zinc ore for a new 80-ton concentrating plant recently erected.

Ontario

Boston Creek.—O'Donald claims of 200 acres in this district are under 60-day examination for influential syndicate. Price, if results are satisfactory, is said to be $250,000.

Cobalt.—Kerr Lake produced 204,153 oz. silver during February. This is equal to recent months, although February was three days short.

Pittsburg-Lorrain company is to experiment with a Groch flotation plant. About 10,000 tons of low-grade ore is available for treatment.

Trethewey Silver-Cobalt Mines Co. reports for 1917 that 34,722 tons of 13.3-oz. silver ore yielded an operating profit of $114,935. Dividend No. 15 absorbed $60,000. Silver in ore-reserves decreased from 361,482 to 264,044 oz. Several properties were examined with a view to purchase, and $4819 was spent on one in Cane Township before stopping work. An option has since been taken on the Castle Mining Co.'s property.

Gowganda.—This district is short of fuel, it being almost impossible with deep snow to cut wood. Mining situation is reported to have never been better.

Kirkland Lake.—Elliott-Kirkland company has opened from 18 to 24 in. of rich gold ore on 425-ft. level. This is considered an extension of Kirkland Lake company's vein.

Teck Hughes company in February treated 2374 tons of $7.27 ore.

Tough-Oakes company has cut a new vein on 350-ft. level, assaying $20 per ton across 6 feet.

Port Colborne.—International Nickel Co.'s new refinery will be finished within a few months. Capacity is 20,000,000 lb. of nickel per annum.

Temagami.—Near Doherty siding silver ore has been discovered and a number of prospectors are busy. Between 1907 and 1910 a good deal of work was done in the district, revealing little of importance.

CHILE

Casapalca.—Backus & Johnston smelter in January produced 1,921,839 lb. copper. Average per month in 1917 was 2,025,697 pounds.

KOREA

Unsan.—Oriental Consolidated Mining Co. reports for November that 200 stamps crushed 25,882 tons of ore. Extraction by amalgamation and cyanidation was $139,410. Operations cost $73,638, and improvements $3010, leaving $62,762 net.

January clean-up, as cabled, was valued at $125,280.

MEXICO

Aguascalientes

Aguascalientes.—American Smelting & Refining Co. refuses to compromise with State authorities regarding the tax levied. This amounts to $9000 per month, which the State offered to reduce to $1500.

Mexico

Mexico City.—A decree issued March 23 prohibits exportation of gold in bars and of Mexican and foreign gold coins. It provides for the exportation of gold and silver bullion by special permit in each case. As to the exportation of ore and concentrate containing gold and silver, the decree issued in September is still in effect. Silver pesos may be exported, by special permit in each case, if gold to the same value is imported in return. The decree exempts gold in bars and National and foreign gold coins from consular fees and does not require consular invoices.

A U. S. Consular Report states that the Mexican government has issued a decree fixing taxes as follows on petroleum lands. First, on petroleum lands being developed by lessees under contracts made prior to May 1, 1916, 10% of the annual rental up to ₱5 per hectare, 20% of the annual rental from ₱5 to ₱10 per hectare, 50% of the annual rental above ₱10 per hectare, and 5% of all royalties paid by the lessee to the lessor; second, on oil lands being developed by the owners of the land ₱5 per hectare annually, and 5% of the products annually; third, oil lands for which no rental is being paid are taxed ₱5 per hectare annually, and oil lands on which no royalties are being paid are taxed 5% of the products annually.

Since 1913, according to figures issued by the Department of Commerce, Industry and Labor, gold and silver valued at ₱125,000,000 have been extracted in Mexico. In the same period copper production was ₱31,000,000, and lead ₱5,000,000.

Utah section of A. I. M. E. entertained, on April 4 at Salt Lake City, the Institute president, **Sidney Jennings**; first vice-president, **Charles W. Goodale**; and secretary, **Bradley Stoughton**. **V. S. Rood** and **J. A. Norden** read a paper entitled, 'Engineering problems encountered during the recent mine fire at the Utah Apex mine at Bingham, Utah.' On April 8 the Columbia section of the A. I. M. E. entertained the above officials at Spokane, Washington. During the period of June 16 to 20 the San Francisco section will also entertain them. No definite date has yet been fixed.

The Australian Institute of Mining Engineers on January 21 elected **J. W. Sutherland** of the Golden Horse-Shoe mine, at Kalgoorlie, Western Australia, president for coming year. The annual report states that 117 members are on active service, several of whom have been decorated for conspicuous bravery.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Henri Jequier is here from Penarroya, Spain.

J. B. Tyrell was at Tulsa, Oklahoma, last week.

Samuel H. Dolbear has returned from Washington.

F. L. Sizer, after a visit to Merced, has gone to Arizona.

D. M. Riordan is expected in San Francisco from New York.

Clyde E. Tilford, of Ely, Nevada, has joined the 27th Engineers.

George H. Garrey is on geological examination work at Tonopah, Nevada.

R. S. Baverstock, of Baverstock & Payne, Los Angeles, was here this week.

F. A. Fahrenwald of Cleveland, Ohio, is expected shortly in California on his way from Arizona.

S. A. Ionides enlisted in a Canadian regiment and is now in the Explosives Department at Ottawa.

D. D. Homer, recently superintendent of the Jerome Del Monte mine, at Jerome, is in San Francisco.

H. L. Christensen has resigned as mill superintendent for the Alaska Juneau. He is now in San Francisco.

Hanzo Murakami, geologist of the South Manchurian Railway, is in Utah studying American mining methods.

Bulkeley Wells, Robert E. Cranston, Roy H. Elliott, and **Wilbur H. Grant** are now at 313 Hobart Bdg., San Francisco.

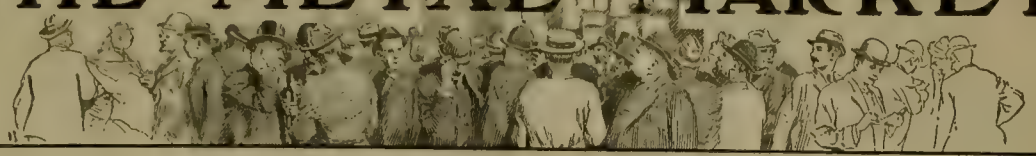
Frank Crawford, superintendent for the Doctor-Jack Pot Mining Co., has been appointed superintendent for El Paso Consolidated Gold Mining Co., at Cripple Creek. He succeeds **Owen Johnson**, who resigned.

Allen H. Babcock has been appointed Western representative of the Naval Consultation Board. Inventions likely to be useful for the War should be submitted to him at his office in the Southern Pacific building, San Francisco.

A. F. Brigham, late general manager of the Jaegersfontein diamond mines, South Africa, has been appointed general manager for the Hollinger Consolidated at Porcupine, Ontario. **P. A. Robbins**, formerly general manager, will be managing director.

The California State Civil Service Commission announces two examinations for senior and junior geological draftsmen, to be held at Sacramento, San Francisco, and Los Angeles during the year 1918, on April 20 and October 19. The salary ranges from $100 to $150 per month for the senior, and $75 to $100 for the junior draftsman. Duties of the senior include the compilation and drawing of topographical, geographical, and geological maps, and geological cross-sections from field notes and other data. Duties of the junior include map tracing, compilation of geological data, and the drawing of cross-sections from field notes. Candidates as senior draftsman must be graduates of recognized engineering colleges, or must have had at least three years varied experience as a draftsman, and a common school education. Candidates as junior draftsman must have had at least two years of work in an engineering college of recognized standing, or at least two years varied experience as a draftsman, and a common school education. A knowledge of geology and mineralogy is desirable in both positions. Persons desiring to enter either of these examinations may secure application blanks from the Commission at the Forum Bdg., Sacramento; Ferry Bdg., San Francisco; and Hall of Records, Los Angeles.

THE METAL MARKET



METAL PRICES

San Francisco, April 2

Aluminum-dust (100-lb. lots), cents per pound	70
Aluminum-dust (ton lots), cents per pound	60
Antimony, cents per pound	13½
Antimony (wholesale) cents per pound	13¼
Electrolytic copper, cents per pound, in carload lots	23½
Electrolytic copper, cents per pound, in small quantities	24⅝
Pig-lead, cents per pound	7½— 8½
Platinum, hard metal (last quotation), per ounce	$108
Quicksilver, per flask of 75 lb	$105
Spelter, cents per pound	10
Zinc-dust, cents per pound	17½

ORE PRICES

San Francisco, April 2

Antimony, 45% metal, per unit	$1.10
Chrome, 38% and over, f.o.b. Cal., per unit	$1.25— 2.00
Magnesite, crude, per ton	$8.00—10.00
Manganese, 40%, f.o.b. New York, per unit	$1.20
Manganese, 40%, at Heroult, Cal., cents per unit	75
Manganese, chemical, per ton	$80—100
Tungsten, 60% WO_3, per unit	$24
Molybdenite, per lb., 85% MoS_2 (nominal)	$1.80
Pyrites, domestic, per unit of sulphur, cents	28

Chrome prices are to be fixed at an early date, probably between the above-mentioned figures.

EASTERN METAL MARKET

(By wire from New York)

April 2.—Copper is quiet. Lead is dull and easier. Spelter is inactive and lower. No quotations for platinum.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver.

Date		Average week ending	
Mch. 27	92.12	Feb. 19	85.48
" 28	92.12	" 26	85.30
" 29	92.12	Mch. 5	85.12
" 30	92.12	" 12	85.66
" 31 Sunday		" 19	86.71
Apr. 1	92.12	" 26	91.27
" 2	92.12	Apr. 2	92.12

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

A lag factor in the recent rise in silver is through China's import season just coming to an end, and its exports are beginning to assume customary large business. These Chinese exports are paid for in bar silver. Hence a large increase in that country's demand is expected. Another factor which accounts for the silver scarcity is low stocks at smelters. The severe winter not only hampered smelter output, but transportation was seriously impeded. This caused smelters to use up stocks on hand, and the winter restrictions are just beginning to have an important effect on the silver market.

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Mch. 27	23.50	Feb. 19	23.50
" 28	23.50	" 26	23.50
" 29	23.50	Mch. 5	23.50
" 30	23.50	" 12	23.50
" 31 Sunday		" 19	23.50
Apr. 1	23.50	" 26	23.50
" 2	23.50	Apr. 2	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Dividends paid by copper companies during first quarter of 1918 totaled $36,717,447, against $45,362,926 in 1917, and $29,537,100 in 1916.

Refining charges of the Nichols Copper Co. at Laurel Hill, New York, have not been increased 33%, as stated here on March 23, but it is probable that this and other refiners will ask the Government to include in the new price for copper to be fixed after June 1, an additional charge, say ½c. per lb., so that refineries can operate at maximum production in these abnormal times.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Mch. 27	7.25	Feb. 19	7.08
" 28	7.20	" 26	7.10
" 29	7.20	Mch. 5	7.33
" 30	7.20	" 12	7.25
" 31 Sunday		" 19	7.25
Apr. 1	7.15	" 26	7.25
" 2	7.15	Apr. 2	7.19

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Mch. 5	110.00	Mch. 19	115.00
" 12	115.00	" 26	115.00
		Apr. 2	105.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	....	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Mch. 27	7.50	Feb. 19	8.00
" 28	7.37	" 26	8.00
" 29	7.37	Mch. 5	7.91
" 30	7.25	" 12	7.79
" 31 Sunday		" 19	7.75
Apr. 1	7.25	" 26	7.56
" 2	7.25	Apr. 2	7.33

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Judge Mining & Smelting Co. of Park City, Utah, made its initial shipment of 240 tons of electrolytic spelter last week.

PRICES OF CHEMICALS

New York prices are as follows:	Per bound
Acid, hydrochloric, c. p.	$0.08
Acid, nitric, 42°	0.09
Acid, sulphuric, 60°, per ton	35.00
Acid, tungstic, per lb. of W	1.85
Ammonia, 26°, in carboys	0.24
Arsenic, white	0.17
Borax crystals, in sacks	0.07
Caustic potash, 88 to 92%	0.84
Caustic soda, 76%	0.04
Lead acetate, white	0.16
Litharge	0.09
Manganese dioxide	0.70
Potassium cyanide, 98%	2.50
Potassium nitrate	0.27
Potassium permanganate	4.00
Silver nitrate, per ounce	0.54
Soda ash, 58%	0.03
Sodium cyanide	0.38
Sodium sulphide, 30% crystals	0.03
Zinc-dust, 350-mesh	0.15
Creosote oil, 25%, per gallon	0.33
Cresol	0.18
Pine-oil, f.o.b. Florida, per gallon	0.44
Pine tar, thin, 1.060 to 1.080 specific gravity, per gallon	0.30

Eastern Metal Market

New York, March 27.

All the markets are quiet, in some cases lower, and in no case have they advanced.

Copper is featureless and is closely controlled.

Tin has been active again for futures, with spot metal nominal and unobtainable.

Lead is quiet and easier.

Zinc is not active, but is considerably weaker.

Antimony is nominally a little lower.

Revised prices of the iron and steel schedule were announced yesterday at Washington. The revision is not extensive. It is to hold for three months more from April 1, though earnest efforts were made to lengthen the period. Actually, few changes were made. Basic pig-iron was advanced $1 per ton, bringing it to $32, and bessemer iron, $1.10 per ton, that is, $35.20, foundry iron being left unchanged. The only other change made in the entire schedule was a reduction of $1 per ton in heavy melting-steel scrap. The arrangement is satisfactory to the large steel-makers, excepting the question of its duration. Such producers expressed a willingness to sell ingots and slabs to the smaller plate producers at special prices so that the latter might continue to roll plates at a fair profit. These desired higher prices on plates.

"The effort of the Shipping Board to get ships from the manganese-ore trade with Brazil is a matter of concern to the entire steel industry," says 'The Iron Age.' "The development of domestic manganese supplies proceeds slowly, but considerable increase is promised for the second half of the year. Meanwhile an increased use of spiegeleisen will be of some help."

COPPER

There have been no new developments in the past week, and the situation appears to be satisfactory. Inquiries as to supplies elicit the information that there is at present enough to go around and that, while the output is not at the maximum capacity, it is expected to reach 200,000,000 lb. per month in the near future. This output will be necessary to fill all international demands, which are the greatest ever recorded. Railroad congestion, or incapacity, still exerts its influence on the copper market, but not as strongly as heretofore. Some consumers not having Government work still meet difficulty in securing supplies, and are also in the market for early and in some cases for prompt delivery, but the tendency is not to meet these wants fully, in order to conserve supplies. All trading is regulated by the Government price of 23.50c. for carload and larger lots, and 24.67½c. for less.

TIN

Last Wednesday, March 20, there were good sales of future metal at 76c. per lb. and upward; more could have been sold had there been sellers. This was also true of Thursday and Friday when considerable inquiry was noted. The feature of the situation is that sellers are really scarce; hence that it is difficult for buyers to cover. A serious phase of the situation is that many foreign houses actually have grown weary of doing business here. Trade comment is to the effect that no blame justly can be attached to them, because the conditions in this country are positively 'rotten'—as some express it. These dealers are now subject to all manner of Government regulations, red tape, and other difficulties, so that they are losing large sums in interest and through other charges. On Monday, March 25, a fair business was done, but the market is now quiet. Arrivals to March 25, inclusive, were 1472 tons, with 6300 tons reported afloat. The London market has fallen as compared with that of a week ago. Yesterday, spot Straits was sold at £317 10s., or £4 under sales made a week ago.

LEAD

It is stated that odd lots have been offered in the last week at 7c., St. Louis, or 7.17½c., New York, but it is probable that these were special offers to special buyers, and that they do not represent the market. They are indicative, however, of the fact that the tone is quite a little easier. Quotations are fundamentally unchanged at 7.25c., New York, for both the A. S. & R. Co. and the outside market, with the St. Louis price at 7.10c. Railroad congestion has improved enough to relieve the market here of its paucity of supplies. This, together with the fact that buyers are not as numerous, explains the easier conditions. The spot market is quoted at about 7.37½c., New York, which is a little lower than last week. Jobbing lots of five tons and less, which a short time ago brought 7.75c., were not accepted when offered this week at 7.50c., New York.

ZINC

The market has grown weaker than was thought possible some weeks ago. Prime Western for April delivery, even for May and June, has been offered and sold as low as 7.25c., St. Louis, or 7.50c., New York. One large dealer quotes as low as 7.12½c., St. Louis, today. Undoubtedly the market is lower than a week or two ago, but just what the time-level may be is hard to define. It is believed that sales have been made—small ones likely—by means of quietly negotiated transactions. It is also market opinion that some dealers have been or are pressing their product on the market, and that this is the cause of the present weakness. Without question the metal is cheap at the above prices, and if any demand exists it should come out now. Some dealers are unwilling to meet these prices, contending that sales at those levels represent an actual loss. Grade A is officially held at 15c. per lb. and is in strong demand for Government uses. Sheet-zinc is pegged by the Government at the 12c. per lb. basis.

ANTIMONY

The market is nominally lower at 13 to 13.25c. per lb., New York, duty paid, for Chinese and Japanese grades. Demand is very light. Imports of matte, regulus, and metal in 1917 were 35,649,113 lb., against 19,749,830 lb. in 1916, and 17,484,030 lb. in 1915.

ALUMINUM

There has been no development since a week ago. Official prices on scrap have not been announced. On No. 1 virgin metal, 98 to 99% pure, the Government price of 32c. per lb. for 50-ton and larger lots rules; while for 15 to 50-ton lots, 32.10c. is the price, with 1 to 14-ton lots pegged at 32.20 cents.

ORES

Antimony: The quotation is about $1.75 per unit, but only a light business is reported.

Tungsten: The market has been active and scheelite has sold at $24 to $24.50 per unit of 60% concentrate. Wolframite sold at $24. One dealer reports that off-grade ore has declined $1 per unit. Ferro-tungsten is quiet at $2.25 to $2.40 per lb. of contained tungsten. For domestic consumption $2.40 is asked, while the lower quotations apply to foreign inquiries.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

DRY CONCENTRATION OF ORES

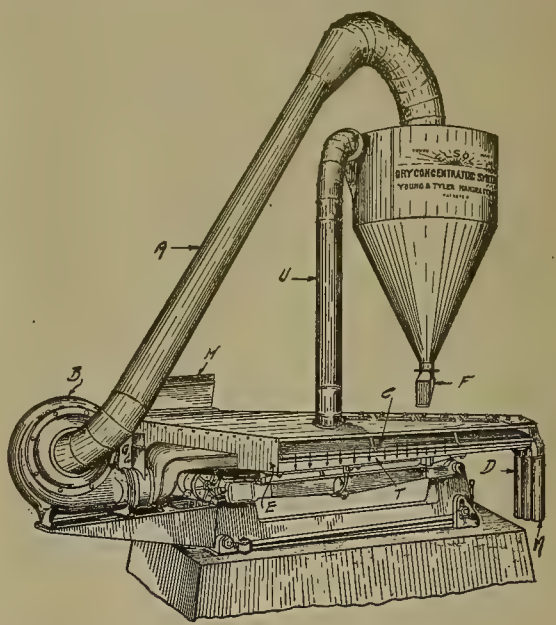
Several mining regions in the Western States have barely enough water for ordinary mining operations and domestic use, but none for ore-dressing. Examples are the well-known Goodsprings zinc-lead district of Nevada and the Quartzsite gold placer district of Arizona. Here, dry concentration is practised.

The subject of dry concentration has been studied more or less for years. Various types of dry concentrators and dry washers have been developed, with varying success. Theoretically, dry concentration should be simple, where applied to ores in which the metallic particles have a specific gravity appreciably higher than the gangue matter with which they are associated, since it is merely a matter of sufficient agitation to cause a stratification of the various minerals by gravity, then removing each strata in turn. The problem is complicated, however, by the various grades and sizes of ore to be derived and, practically, it is not so easy. The mechanism required for agitation and continuous flow of material over the concentrating surface is a problem requiring careful consideration, for to be practical mill equipment it must not only produce rapid stratification and flow, but it must also be simple, free from excessive wear, and easily taken care of.

A great objection to many dry concentrators in the past has been enormous quantities of dust thrown into the air by the combined agitation and air system usually employed for stratification, thus making them practically impossible for mill work. The Elsol dry-concentrating system has not only accomplished what was possible in the way of stratification and concentration, but has also fully met the requirements of practical mill equipment. The machine is simple, compact, and built in complete units easily installed; also quickly adjusted to meet the needs of each ore. There is practically nothing to get out of order, and wearing parts are reduced to three plain bearings outside of those of the blower. All dust is automatically taken care of by the air system. Power required is from less than 1 hp. on the smallest size to 3 hp. on the largest. Capacities range from 1 to 12 tons per hour on coarse-crushed quartz ore, and from 2 to 40 tons on ordinary gold placer material.

The specific action of the Elsol concentrator will be better understood by reference to the sketch.

A specially constructed, single piece, metal surface 'C,' over which the crushed ore is made to travel, forms one of the principle features necessary for efficient concentration. This surface is formed by special dies into V-shaped corrugations or riffles tapering from a relatively larger cross-section at the feed end 'H' to small cross-section at the concentrate discharge end 'D.' One side—the front or bottom side—of these corrugations is perforated with tiny nozzle-like openings through which air is forced from air-chamber 'E' on which the surface is mounted. The air shooting through these tiny perforations, together with a rapid table movement, quickly causes stratification of the material. Once stratified, the progressive movement and reduction of cross-section of corrugations continually causes an elimination of the top strata of material in each riffle, until the discharge-end is reached, where the gangue matter has practically all been eliminated. Whether the concentrate is fine or coarse, providing it is caught in the valley of the riffles, it cannot escape, as the movement continually crowds the heavy particles into the valley, and no air comes in contact with the particles thus reaching the bottom. A certain proportion of very fine material, due to air and agitation, will rise from the table surface. This is drawn up through the uptake 'U' and collects and discharges at 'F.' The re-



DIAGRAMMATIC VIEW OF ELSOL DRY CONCENTRATOR

turn air circuit 'A' connects with the exhauster-blower 'B,' which serves the double purpose of supplying air to the air-chamber and collecting the fine simultaneously. A blast-gate, plainly seen in the illustration, between the blower and air-chamber, properly regulates the air supply. These machines are already operating in the field with a success heretofore unknown to dry concentration, treating lead-zinc, lead-silver, antimony (both oxide and sulphide), wulfenite, tungsten, copper, tin, and gold (both quartz and placer) ores. One plant is at the Red Chief mine in Arizona. Another is at the Buckboard mine, Johannesburg, California, where the saving has been as good as amalgamation. Recoveries have been as high as 91%. Average saving is 75%.

CONCENTRATING ZINC ORE

Plat-O concentrator, model 17, made by Deister Machine Co., Fort Wayne, Indiana, may be changed from a sand into a slime table by adding a number of pool riffles, or vice versa

if desired. The machine is built in single or double-deck types, and is suitable for all minerals. The makers claim that the head-motion is self-oiling, dust-proof, and simple. The tilting mechanism is also simple and strong. The deck rests on six slipper-bearings, which are self-oiling and dust-proof. By means of the Deister 'plateau' in the dressing or cleaning zone of the table, a clean concentrate and low tailing is made, said to use less water than other tables. The corrugated riffles are made of flat strips of sugar pine, having surfaces grooved. Tests made on this table at the mill of the Connecticut Zinc Corporation, at Oronogo in the Joplin district of Missouri, showed as follows in competition with two other tables, which we will call 2 and 3. Feed assayed 3.85% zinc and 0.12% lead. The Plat-O handled 27.83% of the feed, with 39.36% by 2 and 32.81% by 3; Plat-O producing 36.20% of total concentrate, with 35.03% by 2 and 28.77% by 3. Products assayed as under:

	Plat-O	No. 2	No. 3
Middling, per cent zinc.....	3.08	7.74	7.72
Tailing, per cent zinc.....	1.48	2.39	2.10
Concentrate, per cent zinc...	55.10	57.70	58.20

This shows that the competitive tables rejected more metal in the tailing and returned more to the middling than did the Plat-O. Four other tests were made against No. 2 machine, and all are claimed to be in favor of the Plat-O.

COMMERCIAL PARAGRAPHS

February 'Graphite,' the monthly house organ of Joseph Dixon Crucible Co., New Jersey, contains useful hints on the use of graphite compounds.

Rails, locomotives, cars, tanks, hoists, and steel piling held in stock by the Walter A. Zelnicker Supply Co., St. Louis, are catalogued in Bulletins 235 and 238 issued by this firm.

Flotation oils are discussed in a booklet issued by the Georgia Pine Turpentine Co. of New York. This firm makes pine-oils at Fayetteville, N. C., and Collins, Ga. Stocks are kept at Salt Lake City.

Robert Scott informs us that he has recently installed a furnace of his largest type at the New Almaden quicksilver mine, also a 20-ton furnace at the Great Eastern mine, Sonoma county, California.

The Hercules Powder Co. has a plant at San Diego, California, for the manufacture of potash extracted from kelp. The cost of the plant was $1,500,000. This company is shipping acetone to the East in tank cars.

Special publication 1585-A of the Krantz Manufacturing Co., Inc., Brooklyn, New York, deals with safety auto-lock electric switches. These switches are enclosed, intended for use on main circuits, and are absolutely safe, it being impossible to touch live parts.

General Electric Co., Schenectady, New York, has issued a leaflet illustrating its drum-type switches for throwing small alternating or direct-current motors across the line, without the use of starting resistance. We have also received indexes to descriptive bulletins and sheets, also to supply-part bulletins.

Pittsburgh Wood Preserving Co., Ohio Wood Preserving Co., Michigan Wood Preserving Co., Acme Tie Co. of Michigan, and Century Coal Co., of which Grant B. Shipley is president, have moved their offices from the Commonwealth Bdg., Pittsburgh, to larger quarters in the Century Bdg., same city.

Westinghouse Electric & Mfg. Co. has moved its office from Phoenix to Tucson, Arizona. J. H. Knost and W. G. Willson are the representatives there. The company has secured exclusive sales agency in the United States for Frankel solderless connectors, much used for joining wires and cables. Frankel testing clips will also be distributed by the Westinghouse company.

Chester W. Larner announces incorporation of the Larner-Johnson Valve & Engineering Co., at the Widener Bdg., Philadelphia. This company has acquired exclusive rights for the Johnson hydraulic valve, Johnson differential surge-tank, and other hydraulic specialties. The Johnson valves will be manufactured for this company exclusively by the Wellman-Seaver-Morgan Co., Cleveland, Ohio.

Gyratory crushers made by the Traylor Engineering & Mfg. Co., Allentown, Pennsylvania, are described and illustrated in Bulletin G-4. These are so well known that no details are necessary. Sizes range from No. 2 of 12½ tons capacity per hour, to No. 60, of 1200 tons. The former weighs 5.15 tons; the latter 375 tons. Some operating hints are given. Revolving screens and small hoists are given brief mention.

Worthington Pump & Machinery Corporation announces that, effective March 1, James E. Sague, vice-president, is in charge of engineering and manufacturing; Leon P. Feustman, vice-president, is in charge of general commercial affairs, including contracts, prices, purchases, traffic, etc.; and Frank H. Jones, vice-president, is in charge of sales. Their offices will be at 115 Broadway, New York. William Goodman is assistant to vice-president, and William Schwanhausser is chief engineer, also in New York. Neil C. Lamont is works manager, Laidlaw Works, with office at the plant, Elmwood place, Cincinnati, Ohio. Edward T. Fishwick is general sales manager, and Charles E. Wilson is assistant general sales manager, also in New York.

History of the house of Ludlow-Saylor Wire Co., St. Louis, Missouri, is briefly described in its last bulletin. Business commenced in 1856 as Ludlow's Wire Works, the present firm being incorporated in 1875. Both the principals are dead. Present management is as follows: William Duncan, chairman of board; Guilford Duncan, president; Frank Low, vice-president and sales manager; E. J. Gould, vice-president and general superintendent; and D. I. Meier, secretary and treasurer. Capital is $600,000. The plant covers 200,000 sq. ft. of floor-space. All classes of wire-cloth and mine screens are manufactured, the latter output being 10,000,000 to 12,000,000 sq. ft. per year. Three hundred people are employed, many of the weavers being with the firm from 20 to 25 years, and numbers with 10 years experience. Essentials for screens are strength, durability, efficiency, resistance to abrasion and shock, preservation of original form, and stiffness when unsupported.

Announcement is hereby made that the exclusive right, privilege, and license to manufacture and sell, in the United States and its possessions, the Overstrom concentrator (Overstrom Universial Concentrating Table) as covered by application for U. S. Patent, Serial No. 132387, filed November 20, 1916, and the circular arc-motion of the table, riffles substantially parallel to the motion, laminated spring supports, etc., have been granted to George A. Scott, to begin at once in accordance with a contract between Gustave A. Overstrom, Charles V. Craig, and George A. Scott. By the terms of the foregoing contract, the entire business, assets, and obligations of the Overstrom Manufacturing Co., as of January 1, 1918, are assigned to and assumed by George A. Scott, who will continue the business under the name of the Overstrom Manufacturing Company, with principal offices at 607 First National Bank Bdg., San Francisco, Cal. It is therefore requested that all orders, remittances, and inquiries be sent to the latter address, where collections of accounts may also be made.

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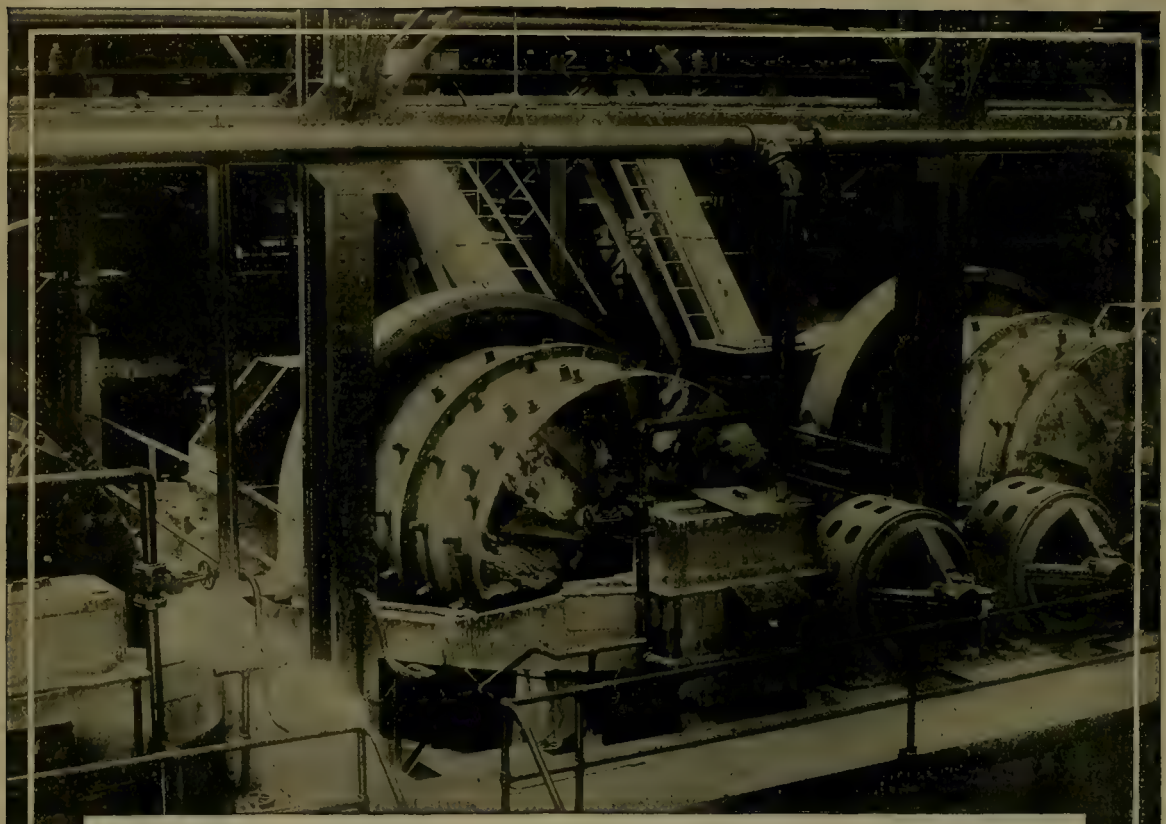
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IN the article on 'Testing an Air-Compressor,' by Mr. Walter S. Weeks, in our last issue, there was a typographical error in the tabulated statement on page 482, where the cubic feet of air corresponding to a water-column of 12 inches should have been 74.36, and for 13 inches, 77.44. The error would be detected by a careful reader, and by comparing the figures with the chart of nozzle-discharge; however, we mention it in justice to the author.

THE silver bill drafted by Mr. Key Pittman, Senator from Nevada, has been approved by the Treasury Department. The quantity of coin that would be melted under this bill, if it should become law, has been increased to $250,000,000. The measure is now before Congress. This plan for releasing silver for export, and gradually replacing it by renewed purchases of bullion in the market, was discussed editorially in our issue of February 16. Its effect would be to expand credits against a metallic basis, at the same time offering relief and incentive to the silver miners at a time when a market at prices fixed by the Government will be particularly useful to them, and will enable the producers to contribute to the financial strength of the country, as they have done at other periods of national stress.

RECENT reports from the great Bawdwin mine of the Burma Corporation show an increasing proportion of copper in the ore, which hitherto has been mainly valuable for silver, lead, and zinc. On the fifth and sixth levels high assays of copper have been recorded, in one case the copper content for 854 feet ranging between 7 and 21%. This is interesting, for it may presage the uncovering of a large tonnage of copper ore. American experience has shown that silver and lead near the surface are succeeded in depth by copper often enough to justify the expectation of such an order of deposition. The average miner and prospector can be restrained with difficulty from arguing that the relation has been proved to be a necessary sequence. The mines at Butte were originally worked for silver, and the appearance of copper brought discouragement at first; lead and zinc are found in association with these deposits, and the magnitude of the zinc output of the Butte & Superior, Elm Orlu, and other mines bids fair to rival the copper production of the district. At Bisbee lead, as well as copper, was found at the surface in the early years of development, and it is still a factor in the metallic output, whereas zinc is found in many places, particularly associated with the deep pyritic ores of the Calumet & Arizona. The Yankee Girl, in Colorado, was started as a silver-lead mine, although it achieved fame as a source of copper ore, containing the precious metals. Other examples will come to the mind of the reader.

IN our issue of March 16 we published two letters protesting against the imputation, made by our correspondent in Mexico, that the Compañia de Minerales y Metales was German-controlled and we were informed that 97.7% of the stock was held by the American Metal Company. On April 4 an Associated Press dispatch announced that two directors of the company last mentioned had "been given permission to open negotiations in Switzerland with German holders of 40% of the stock of the company." If 40% of the parent company is German and if it owns 97.7% of the subsidiary, then at least 39% of the subsidiary is German controlled; this does not include the holdings of naturalized Germans; in short, the German share-holding is large enough to warrant the phrase "German-owned," to which strong exception was taken by an engineer for whom we have sufficient regard and respect to regret a decided difference of opinion.

AMONG the feats of engineering contributing to the successful waging of the War we like to record the manner in which the interned German ships were made ready for use after they had been damaged. The Germans did such damage as would, they estimated, put the vessels out of service for two years. The 37 German ships, of 700,000 total tonnage, had their 74 engine cylinders so broken that speedy repairs seemed impracticable. Some of the castings required for the biggest vessels were supposed to be beyond the capacity of any American foundry. The Shipping Board estimated the bill for repairs at $2,600,000, and the time required at 18 to 24 months, yet the job was accomplished in 7 months at an expense of only $273,000. One of the first ships tackled had four broken cylinders and it was estimated that 18 months' work would be required, but

within 60 days the engines were repaired, and within 90 days the vessel was ready for sea; indeed the time taken for repairs in many instances was hardly more than that needed for such overhauling of the machinery and cleaning of the bottoms as was necessary after so long a period of inactivity. Many of these ships are now stronger than before, and they are being operated more cheaply than by the Germans. The most striking example is the 'Vaterland', which is 907 feet long, or 200 feet more than the height of the Woolworth building in New York, and is rated at 54,282 gross tons or 23,548 tons net. She has 18 decks and 18 elevators. Cylinder castings weighing 70 tons each were required and there was no dry dock big enough to hold her except at the Panama canal. The thirteen breaks in the cylinders were patched by electric welding, without a single rivet having to be put through the 3½ inches of metal. Many improvements were made and within a few months after seizure the great ship went forth at a 21-knot speed using 200 tons per day less coal than before. She is now called the 'Leviathan', and is credited with transporting 15,000 soldiers in a single voyage across the Atlantic, making her last round trip in 11 consecutive days. The Germans were misled—they were badly fooled—by their conceit. American invention and enterprise used constructively was more than a match for their sabotage and meanness used destructively.

WATER-POWER development at length has emerged from the realm of academic discussion into that of practical consideration by the leaders of industry. A year after assuming belligerent responsibilities in a contest that jeopardizes the future welfare of the Republic, the stupidity of our restrictive national policy toward the utilization of water-power has been realized. Congress now has the question before it in the form of a bill, on which early action is expected. The Chamber of Commerce of the United States, representing half a million of the progressive men of the country, has registered its conviction that proper enabling legislation is urgently required. It is pointed out that the available undeveloped water-power of America exceeds the total steam-power at present in service. Most of the water-power is controlled by the Federal government. The advantage of hydro-electric power, from a financial standpoint, is not as pre-eminent as the public has imagined, because it requires a very large initial investment, and it is not so readily increased as steam when necessary to meet a growing demand. The conditions under which it may be controlled must be freed from onerous burdens in order to make it attractive to capital. This has not been done in the past. It must be noted also that efficiency in steam-engineering has become so great as to admit of generating power with coal in competition with water-power at many Eastern points. On the other hand, the saving in the conservation of fuel and labor, and the release of an enormous carrying capacity of the railroads to more urgent uses, is of such vital moment in the present crisis that strenuous efforts are needed to permit the harnessing of water-power with the utmost speed. The merits of the bill before Congress may be open to discussion, but the debate must be decisive and practical, and, above all, of a constructive sort, leading to a wise decision without waste of precious time. It is the duty of every citizen to urge upon Congress that this measure be dealt with promptly, and in a broad spirit commensurate with the tremendous National issue at stake.

SUFFICIENT attention has not been paid to the fact that Germany is playing a clever game in her economic dealings with the Ukraine and Rumania. The German papers characterize the treaty with the Ukraine as a 'bread peace,' and that with Rumania as an 'oil peace.' This accentuates the special needs of Germany, but, on the other hand, she is not oblivious to the necessities of the peoples who have been forced to make terms with her. Certain German factories have been assigned to the production of goods urgently required in the conquered districts, and careful attention has been given to stabilizing exchange, so as to facilitate commercial intercourse. This tends to repair the ravages of war, and to ease the conditions of living, thereby promoting a revival of friendly feeling. Another device for re-establishing confidence is that of making part-payment for Russian goods in Russian securities, thus encouraging the development of industrial operations and the rehabilitation of the railways, by definitely placing the control in the hands of domestic capitalists. In the face of this it will be seen that German commercial penetration is being accomplished by methods that tend to allay animosities and to give the Central Empires a strength in the East that will increase their power of resistance. It also lessens our right to expect political opposition in Russia in aid of our cause. To count upon any effective uprising there is to base our campaigns upon false hypotheses. Germany is now using economic weapons where we cannot reply in kind. It makes more imperative the need of developing our military offensive to the highest degree of efficiency and strength, for it is by arms alone that we can win.

Oil-Shale in Colorado

We publish another article on this subject, this time by our regular correspondent at Denver, Mr. Arthur J. Hoskin, a mining engineer particularly well informed concerning the mining industry of Colorado. The article is sufficiently comprehensive to give an excellent general idea of the conditions governing this new departure in mineral exploitation. The region now the scene of this activity is one well known to fishermen and to hunters of big game; it is one of the most attractive portions of Colorado. Fortunately the shale deposits have been examined and described by the U. S. Geological Survey, and if public interest in the subject is sustained it may be assumed that the Director of the Survey will arrange for the publication of further information. Although a

comparatively undeveloped industry in this country, the exploitation of oil-shale is a relatively old industry in Scotland, where in 1913 an output of 3,280,000 tons of shale yielded 1,718,000 barrels of crude oil, the average yield being about half a barrel, or 20 gallons, per ton. In Colorado, it is estimated, there is sufficient shale of even greater oil-content to yield 20 billion gallons of crude oil, from which two billion gallons of gasoline may be extracted. These figures suggest the possibilities of one region only, for in Utah and Indiana, for example, other resources of the same kind, and of equal magnitude, are available for judicious enterprise. Mr. Hoskin describes the character of the rock formation, and outlines the methods of mining, development, and distillation. He lays stress on the tentative nature of most of the work now in progress, but writes hopefully concerning the outcome, the ultimate success of which must depend upon adapting Scottish and Australian practice to local conditions. He places particular emphasis upon the need of good engineering advice, pointing to the fact that in such a new field of enterprise it is likely that expert advice will be set aside too readily by the promoters of speculative schemes. The operations require the use of mining, mechanical, and chemical experience such as is readily available, at Denver, for example; therefore the public is advised to insist upon proper guidance in all technical matters, for without it much money will be squandered.

American Smelting v. Bunker Hill

We are informed that the controversy, developing into serious litigation, that has existed for several years between the American Smelting & Refining Company and the Bunker Hill & Sullivan Mining & Concentrating Company has been settled out of court. In our issue of December 1, 1917, and on other occasions, we have referred to the dispute over an ore-contract culminating in a suit commenced by the Smelting company in the Federal Court of Oregon, followed by a petition for a temporary injunction against the continued operation of its own smelter by the Bunker Hill company. When preparations were under way for the trial of the suit it was realized, we are informed, that the contract was so indefinite in many particulars as to afford ground for persistent litigation. Therefore the parties in controversy, by mutual agreement, have cancelled all contracts between them and entered into a new one whereby the Smelting company receives a portion of the ore of the Bunker Hill company at rates that are satisfactory to both parties. In previous references to the subject we have mentioned the salient facts. The principal contract was for a period of 25 years, from 1905, but it provided fixed terms for only the first five years, covering such of the output as contained between 30% and 75% lead. It did not require the Bunker Hill to put its ores through a mill, and, as the ore from the mine averaged less than 15% in lead, it was possible to contend that none of the ore came within the limits specified. As a matter of practice, however, the Bunker Hill company did concentrate most of its ore and its methods of concentration were such that at times nearly a third of its output was a product containing more than 75% lead. As this grade of material did not fall within the binding terms of the contract, it was provided that the Smelting company should have an option to purchase this product by giving the Bunker Hill "the best going market rates and terms." When the latter company built its own smelter, last year, it placed itself in a position, by bidding for other ores produced in the Coeur d'Alene, to make the terms that it should receive for its high-grade product, in the event that the Smelting company should exercise the option. Another interesting dilemma arose over the concentrate of intermediate grade, between 30 and 75%. The contract, as amended, fixed definite terms for the ten years between 1905 and 1915; after that and for the remaining 15 years the Bunker Hill was to receive at least the terms obtaining during the first period and any better terms that might be granted by the Smelting company to a majority of independent 'shippers' in the Coeur d'Alene, so long as the Smelting company should continue to purchase a "majority" of the Coeur d'Alene ore; but if this company should cease to do so, then it was obliged to give the Bunker Hill not merely the terms that had been in force, but was obliged to meet the terms of its competitors in the smelting business. The Smelting company did receive the major portion of the Coeur d'Alene output during 1915, 1916, and 1917 on terms that were no better than those which the Bunker Hill received during 1905 to 1915, therefore the Smelting company, by omitting to make new contracts, was in a position to continue the old terms, assuming the contract to be binding, so long at it refrained from making a market and so long as it retained control of the regional production of lead ore; but it was apparent that a time would come when such inaction would entail the loss of the major production from the Coeur d'Alene and therefore the loss of the Bunker Hill output, or the Smelting company would be compelled to meet its competitors' terms, which necessarily would be affected by the new competition of the Bunker Hill smelter. Meanwhile two of the mines that had been shipping to the Smelting company became exhausted, so that since the beginning of the current year it has not been receiving the "majority of the ores" [a phrase suggesting the poor wording of the contract]. Moreover, the Bunker Hill smelter was receiving so much outside ore that it was not dependent on the output of its own mine, and would have been embarrassed if it had to treat that output in addition to the current receipts of custom ore. The contract was uncertain in its definition of the means for ascertaining the rates accorded by competing smelters, and as these terms might be changed with each new contract made in the region, it seemed likely that the controversy would persist until the expiration of the contract. For these and other reasons both parties concluded to cancel the contract and enter into a new one that promised to obviate litigation.

Undoubtedly they have been wise in so doing, but we regret the event nevertheless, because we have reason to believe that it would have been to the public interest to have a suit in the course of which the methods of smelting companies would have been bared, particularly in so far as they involve preferential rates from the railroads and combinations against the producers of ore. We rejoice, however, that a possible menace to the success of the Bunker Hill smelter has been removed and that this independent plant will continue to exercise a healthy influence in the ore-purchasing business of the North-West.

Prussian or Bolshevist

The Russian debacle, following the impact of the Prussian idea on the revolution that we hailed a year ago as the latest flower of democratic aspiration, presents a sinister picture to the student of social philosophy. On the one hand we see the concrete expression of highly organized and frankly autocratic militarism and on the other the disintegration of a nation plunging into the chaos of sentimental anarchy. To which of these extremes is the world drifting? Apparently it is one or the other if we and our Allies do not win this war soon. Are human beings willing to surrender their conscience to the idea of a State that, like the king of an outworn dogma, can do no wrong, and therefore may commit crime without shame, or are they to assert their individualism to the extreme of destroying all social order? That seems to be the choice of evils offered to civilization today by the pacifist and non-resister. The prostitution of patriotism to a highly effective form of international brigandage has been so fully exemplified by Germany that we are left in no doubt as to the ends and purposes of kultur, the idea of the beast that has the brains of an engineer. We loathe the idea and its many bestial manifestations; we question even the efficiency of its sponsors; to us the claim of superlative sagacity and supreme competence is incompatible with the insanity of plunging into such a war a people that by peaceful penetration was in process of acquiring all the commercial advantages and political influence that it wanted. Has the German proved himself fit for world dominion? The question is derisive. He does not play the game; he has fought bravely, but with a dirty meanness that has provoked contempt; he has no psychical intuition, his diplomacy has been that of the spy; he has proved himself less chivalrous than a pirate and less humane than an Apache. To a Napoleon, a Caesar, or an Alexander the world might, if compelled, yield service, but to the pitiful paranoiac at Berlin it refuses even the respect given to unscrupulous tyranny. To us the Prussian idea, which is now German, is the negation of all that for which we have striven since the United States came into being—nay, since Magna Charta was signed. It stultifies the aspirations of every democracy, of every attempt at democratic government since man emerged from the jungle. It is a return to the brutishness of the ape and the tiger. We repudiate it with all our heart and soul; we shall fight it as long as we have an arm to raise in forceful protest. But what of the alternative that begins to gibber at us from amid the reek of war? Is Bolshevism any better? Let the Russian reply. The bureaucratic regime of the Romanoff did at least ensure some kind of social order, some maintenance of industrial activity, some assurance of food and clothes; now these elementary requisites to human welfare are gone, and with them all that stood for any sort of stability, that is, the rights and responsibilities recognized between members of an organized community. With cynical effrontery the propaganda of the German autocrat has urged the Russian to assert himself to the point of discarding military discipline, repudiating financial obligations, confiscating all forms of property, and labeling every intelligent citizen a 'bourgeois' and therefore anathema. The Bolshevists have served the German purpose only too thoroughly, demoralizing as well as demobilizing the armies that fought so heroically for two years, opening the gate to the invader, and wantonly discarding the intelligence of the country at the moment when it was most needed to guide her destiny. This destruction of the complex machinery of a nation's life is the pestilent growth not of socialism but of anti-social perversion of the true socialistic spirit; it is the expression of unrestrained individualism, for which 'internationalism' is a mere cloak. This political catch-as-catch-can, this anti-social wrestling with all the forms of established order, is a reversion to the jungle; it leads nowhere except to social chaos, that is, anarchy or nihilism. To the liberal, longing for the fulfilment of the American idea—equality of opportunity—it is a bestial satire, no more and no less. It is a curious manifestation of human unreason and it is portentous, for, if the War last long enough, we see the danger of an infection from this intellectual meningitis. The blasts of war may blow the poison-gas across the world. The carnage and destruction of battle cannot continue forever; sooner or later even a disgraceful peace will seem preferable to the weak-minded and feeble-hearted, of whom every nation has a share. It would be in accord with the justice of things if the German propaganda, like their chlorine, were blown back from Russia into their own ranks. It is likely, if a military decision does not anticipate the event. The wish may be father to the thought, and the same wish leads us to hope that the I. W. W. and similar Bolshevist tendencies may be abated both in the United States and in Great Britain. Unless we check Prussianism we shall be endangered by a growth of the non-national, anti-social, purely individualistic and essentially uncivilized spirit of Bolshevism, which, like Prussianism, is the negation of that orderly co-operative and social trend of human affairs for which intelligent men generally—outside Germany—are striving. Our destiny depends upon the winning of this contest against two enemies of representative government—that kind of government on which we stake our existence as a nation—those two enemies being tyranny and anarchy.

Cascade Method of Froth-Flotation

By H. HARDY SMITH

Modern flotation practice is almost entirely concerned with what is now known as air-froth flotation, and the practice of air-froth flotation is in turn largely concerned with methods of getting atmospheric air into intimate association with a mixture of mineral particles in water. The process therefore can be subdivided according to the manner in which the air is introduced, and at present there are three distinct processes, first, the mechanical agitation or Minerals Separation process,

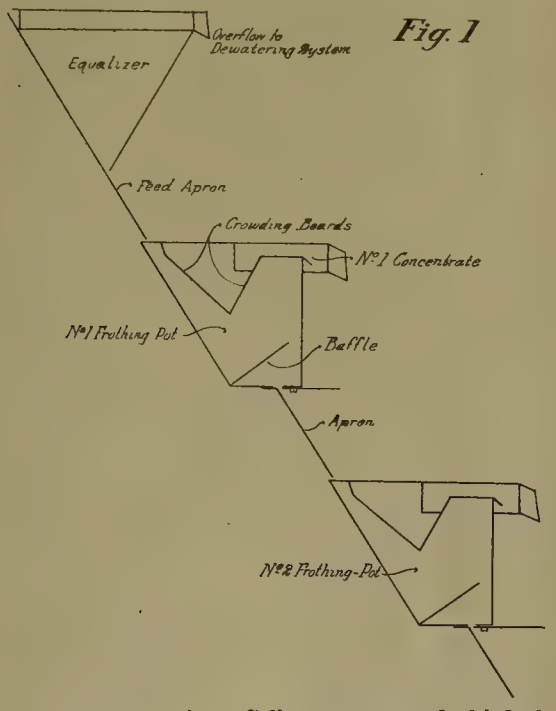


Fig. 1

second, the pneumatic or Callow process, and, third, the fluid-jet air-entraining or Cascade process. The last is of recent origin and at present is in use only to a limited extent in comparison with the other two processes. Owing to its intrinsic merit, however, it bids fair to occupy an important position in the metallurgical use of froth.

The Cascade process works by virtue of the fact that a stream or jet of fluid tends to drive or carry contiguous particles of a surrounding fluid along with it, as a result of the friction at the interface caused by the adhesion between the two fluids. This principle was recognized centuries ago, and was applied by means of the 'trompa' or hydraulic air-compressor, to supply air at low pressures for the Catalonian forges. About the middle of the last century it was employed in the form of the jet-pump and the jet-ejector, and it also enters into the action of the modern steam-injector.

The extraordinarily large volume of air or gas that can be injected by a jet of water against a moderate resistance by this means, leads to the supposition that the force of adhesion between air and water is greater than had been commonly supposed. The operation of the hydraulic air-compressor depends primarily on the grip that a rapidly descending surface of water can obtain on the contiguous air, and the high efficiency, which many of these contrivances have shown, is evidence that the forces engaged are not fickle or elusive, but are constant and reliable.

In the Cascade flotation process, the jet or stream of

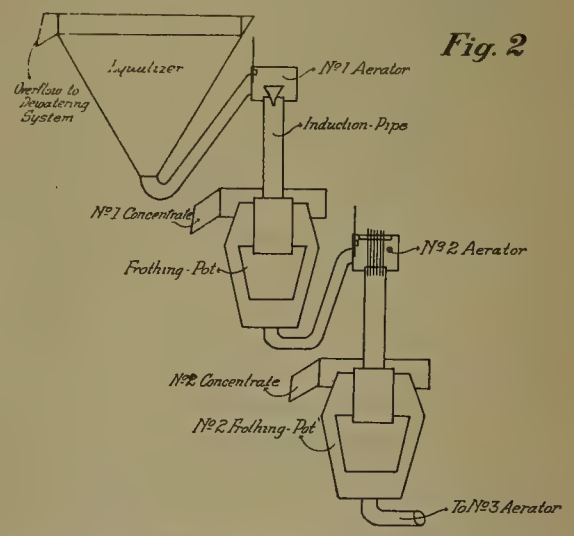


Fig. 2

fluid is not only employed to introduce air into the body of the pulp, but its kinetic energy is absorbed also in producing agitation, so as to thoroughly disseminate the bubbles throughout the mass and to assist them in their grasp upon the mineral particles which are to be floated. This agitation is not to be compared in its intensity to that in the method of mechanical agitation, but is more in line with that produced by the pneumatic process.

It is important to distinguish between the kinds of bubbles. In a froth-flotation sense there are active and inactive bubbles. Air introduced into the body of a liquid necessarily must produce bubbles before it escapes at the surface, since a bubble is merely a certain volume of air surrounded by a liquid, but, from a flotation-standpoint, some air will be consumed in forming useful bubbles, and the remainder will escape without performing any useful purpose. For example, a jet of air blown into a pulp free from a frothing contaminant, even if the other flotation conditions are good, will produce mostly inactive bubbles, and, even if a frothing agent be present,

the proportion by volume of inactive bubbles will be large. Apparently the activity of a bubble is in inverse proportion to its diameter, but there may be other less obvious factors.

In the so-called pneumatic process of froth-flotation, the enormous production of bubbles for a given result is its most striking characteristic, a point which would lead one to suppose that the proportion of inactive to active bubbles is large, and consequently that the 'bubble-efficiency' is low. On the other hand, the froth production for a given result with the Cascade method is decidedly moderate, and consequently the bubble-efficiency must be relatively high. In this respect it probably does not equal the method of mechanical agitation, but the large consumption of energy to produce the bubble and transport it through the pulp to the surface, in the latter method, is an economic drawback. It will be necessary to learn more about the fundamental physical principles governing the production of bubbles in liquids before it becomes possible to indicate the reason for this high bubble-efficiency inherent in a volume of air injected as a film adhering to a fluid surface in rapid motion; but whatever be the reason, the fact remains that this method of introducing air and of agitating brings about the desired results in a particularly pleasing and efficient manner. The Cascade process is the logical outcome of the growing recognition of the importance of air in froth-flotation practice, since anyone of ordinary intelligence could not stand below a waterfall or a cascade, and observe the intense aeration in the pool beneath, without immediately being struck by the potentialities inherent in this method of agitation, were he cognizant of the fact that in this intense aeration lies the basic principle governing the successful froth-flotation of minerals.

On the economical and practical sides the strong points in favor of the Cascade process are: the simple and inexpensive plant, insignificant wear and tear, low repair-costs, small power-consumption, and the meagre attendance and regulation required to keep the plant running under good conditions. The honor and credit for first recognizing the principles underlying the Cascade process, and for embodying them in practical form, seems to be due to Messrs. Seale and Shellshear, of the Junction North mine at Broken Hill, Australia, where a full sized working plant was put into operation about the end of 1914. As frequently happens, the same idea was hit upon and developed independently at practically the same time in other widely separated localities, namely, at the Arizona Copper Co. in the United States and at the Suan mine in Korea. Later on, in 1916, U. S. Patent No. 1,187,772 was taken out by G. E. Ohrn, and another, No. 1,202,512, by Gustaf Gröndal, both of Sweden, for apparatus embodying the Cascade principle. About the same time a simple machine of true Cascade type was evolved at the Mineral Farm mill, at Ouray, Colorado. Recently Commonwealth Patent No. 2353/16 was taken out by L. Y. Waterhouse, of Mt. Lyell, Tasmania, for a novel form of the Ohrn machine. Although all the contrivances developed by the various investigators contains the same fundemental principles, the method of application differs widely. With some of the plants it is claimed that violent preliminary agitation and mixing of the flotation reagents with the pulp is unnecessary, but in most cases it will be found that this is highly desirable. The excellent mixing and emulsification which can be obtained by grinding the ore with the reagent in a tube-mill, in certain cases, may be sufficient, but supplementary agitation of the pulp, diluted to a consistence suitable for flotation, will not, in the general run of cases, be found amiss. In the apparatus developed at the Junction North mine, followed by other mines at Broken Hill, and by the Arizona Copper Co., as well as at Suan, and at Mineral Farm, the force of gravity alone is relied upon to inject the air and to disseminate it through the pulp. If insufficient natural fall is available, artificial fall must be created by means of elevators or pumps, which, at the same time, can be relied upon to provide a certain amount of the desirable preliminary mechanical agitation. In the Ohrn and Gröndal forms, the energy of high-pressure steam is employed, and in the Waterhouse machine, that of high-pressure water or solution. In these latter types it is safe to assume that preliminary violent agitation is not so vital, since the energy expended within the machine itself is greater than in the simple gravity-types.

The necessity for providing equalizing apparatus at the head of the plant is even more important in the case of the Cascade process than in other flotation processes, especially with gravity plants, since the nature of their operation makes them very sensitive to fluctuations in the volume of the feed. This lack of flexibility is one of the chief disadvantages of the process. A plant once designed for a certain tonnage, or more correctly, for a certain volume of pulp per unit of time, will not work satisfactorily at points much above or below this volume, and adjustments to suit altered conditions are not readily made.

In certain cases the froth produced in the Cascade process is extremely evanescent, and if allowed to occupy areas approaching those used with other flotation processes, the result will be failure. Where disappointing results have been obtained in trials with the process, it is fairly safe to assume that this was one of the points not fully comprehended. The ratio of frothing area to capacity is one of the most important considerations in the design of a plant. On account of the frail froth that is liable to be encountered, another important thing is to provide for short travel and rapid removal of the froth-concentrate. A Cascade machine, in the design of which proper attention has been paid to the above two points, will be found particularly efficient on coarse material, or in preferential flotation. In the case of a relatively high-grade pulp, containing a large proportion of readily floatable sulphide slime, the points mentioned may not be of such importance.

Turning to the mechanical details, Fig. 1 is a diagrammatic sketch of the simplest type of apparatus, and the only one which is accurately described by the name

'cascade'. Its chief recommendation is its simplicity. The feed-apron spreads the moving liquid into a sheet, and although this gives a large area, it is not the maximum area in contact with air that the same volume of liquid could provide. This would lead to the supposition that the efficiency of the machine is not high. In the one developed at the Mineral Farm mill, not even crowding-boards were employed, the apron simply discharging into a box of square section, and the float being skimmed off continuously by a paddle. The results are said to be quite satisfactory. The capacity of a plant depends on the length of the frothing-boxes and the intensity and time of treatment on the number of steps or cascades. Both can be increased indefinitely, but it is preferable to have not more than six steps in succession, and, if further treatment is necessary, to interpose an elevating device to raise the pulp to the next tier. The frothing-boxes must be properly designed to suit the hydraulic head of each step, otherwise a loss of energy will result. This applies to all types of gravity machines. With the type shown in Fig. 1, a 30 to 40-in. head will usually be sufficient.

Fig. 3

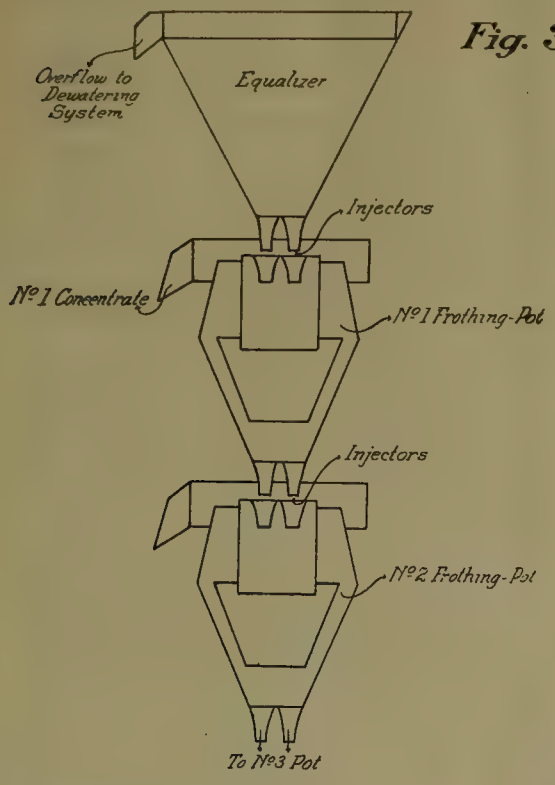


Fig. 4

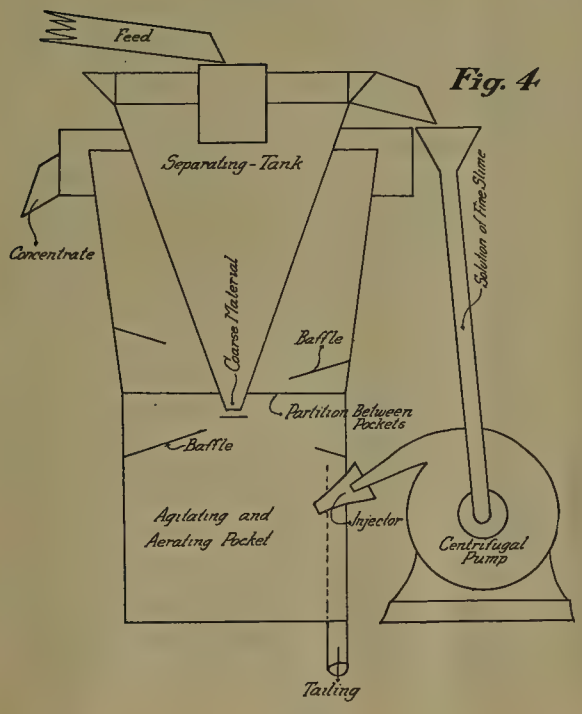
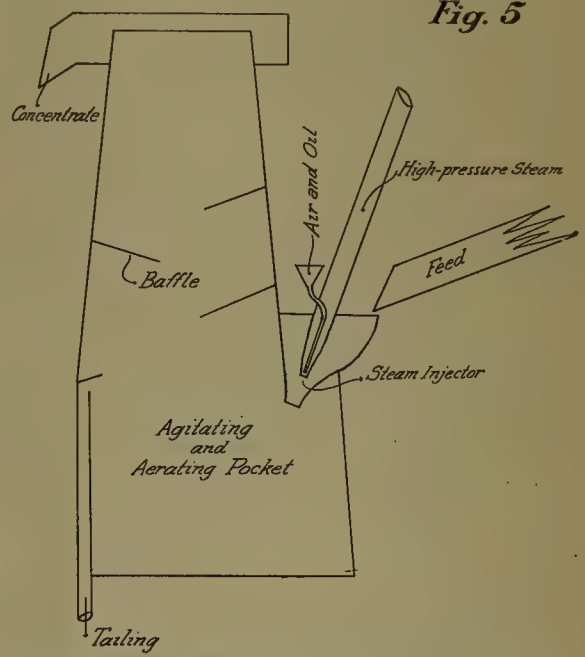


Fig. 5



A more advanced type of apparatus is represented in Fig. 2. In most cases this could be expected to yield better results than the arrangement shown in Fig. 1, yet it is open to the objection that it involves more mechanical complication, and there is a loss of head between the steps, in consequence of which the total fall may not be utilized to the greatest advantage in the aerators. The capacity of the plant depends upon the dimensions of the induction-pipe and the frothing-pot. These cannot be increased indefinitely, so that a multiplication of units is necessary for a large tonnage. Very large volumes of air can be entrained by means of the induction-pipe, either with or without the small air-pipes shown in the aerator in Fig. 2, and this part of the apparatus is undoubtedly efficient both as an aerator and as an agitator, in combination with its bucket or diaphragm. A length of induction-pipe of 25 to 30 inches in the clear will usually give good results, but to get the total height between steps, the loss of head in the aerator (6 to 8 in.)

and in the under-flow pipe from the preceding frothing-pot must be added to it. The latter will depend on the density and coarseness of the pulp under treatment, but it will usually not be satisfactory at less than 12 in. Individual small frothing-pots have the advantage of providing a rapid discharge for the concentrate, and this apparatus is therefore well adapted to coarse material, to refractory ores, or to preferential flotation. The machines developed at the Junction North mine, Broken Hill, and at the Suan mine, Korea, are of this type.

Another type, corresponding to what was developed at the Arizona Copper Co.'s mill, and at the Central mine at Broken Hill, is shown in Fig. 3. Considerable difference of opinion may arise over the relative merits of the two types represented by Fig. 2 and 3, but as they come into more general use, admitting the comparison of operating results, doubtless one will become popular at the expense of the other. With two pots working side by side, one fitted with jets and the other with an induction-pipe, although the froth had a different appearance, the amount of concentrate coming over seemed to be the same. The apparatus shown in Fig. 3 has the advantage of less complication and practically no loss of head, but the jet-injectors must be carefully designed and the nozzle needs frequent renewal. It is found that 30 to 40-in. head, and $\frac{5}{8}$ to 1-in. nozzles, will give satisfaction. When a rapid froth removal is necessary it is desirable to have small individual pots, either of square or round section. Common oil-barrels make satisfactory pots of this class. With many ores, especially where large tonnages have to be treated, oblong pots would be preferable, the length depending on the tonnage that it is desired to treat in each unit. Very long pots are liable to be unsatisfactory on account of the difficulty of distributing the feed evenly.

One of the latest developments in the Cascade type of machine is shown in Fig. 4. It is covered by the Waterhouse patent. A high-pressure liquid jet is used, both to inject air and to agitate the pulp. This machine will doubtless be elaborated and brought to a high state of metallurgical and mechanical efficiency. A pressure of about 80 lb. is used at the jet, and this pressure can be obtained by using a pump, as seen in the sketch. Since only solution and the finest suspended slime passes through the pump, the wear and tear are not excessive. The frothing-pot is made deep, and is fitted with baffles to confine the violent agitation to the lower part of the vessel. The frothing compartment is usually oblong in shape, and the single pump supplies several jets with high-pressure liquid. To get multiple treatment of the feed, each jet discharges into its individual pocket, which is separated from the succeeding pocket by a partition over which the pulp has to travel in order to reach the final pocket where it is discharged. The flotation reagents should be thoroughly mixed with the pulp before being fed into the separating tank, since it is preferable that the high-pressure liquid used at the jet should carry its proportion of frothing-agent before injection.

The apparatus shown in Fig. 5 presents a radical change from the preceding types, but its governing principles bring it within the Cascade classification. In this case the stream of fluid that entrains the air and causes the agitation is not a liquid but a vapor, namely, high-pressure steam, the energy of which is utilized by means of a steam-jet injector. On account of the very low thermo-dynamical efficiency of the latter, this machine cannot be economical except when steam has to be used in any case to heat the pulp. In that special field it had a promising future. Oil is mixed with the steam before it strikes the pulp by being drawn into the jet through the small pipe shown in the sketch. It is claimed that better distribution of the oil is obtained in this way, and the claim is well founded, because the heated and atomized oil should certainly possess great covering power. The jet not only forces in the air for the bubbles, but also injects the pulp into the machine. The exact object of this is not clear, but, in the case of multiple-treatment, it would make it possible to have the series of units on the same level, the tailing from one being led into the feed-hopper of the next. This type of machine is covered by the Ohrn patent.

The ideas covered by the Gröndal patent are similar to those embodied in the Ohrn apparatus, except that the oil is forced into the steam-pipe, and the mixed steam and oil then pass to a Koerting steam-jet apparatus where air is drawn in. The steam, oil, and air become thoroughly commingled, and the mixture is led to the bottom of the agitating compartment, which it enters through a funnel-shaped orifice. Unlike the Ohrn machine the pulp is fed direct into the agitating compartment over the mouth of the funnel. After violent agitation in one chamber, resulting from the entry of the steam-oil-air mixture, the pulp passes to another, where the froth and tailing separate and are removed. The method of feeding the pulp direct into the agitating compartment, instead of through the injector, seems to be preferable, except in the case of the multiple treatment above mentioned.

The various machines that have been devised to take advantage of the Cascade principle have been touched upon in the briefest manner, to indicate the lines along which development has proceeded. Many modifications and elaborations will suggest themselves, to suit local conditions, and a wide field for experiment and research lies open to produce a machine possessing a maximum of the strong points of the Cascade process, with a minimum of mechanical complication.

Hitherto, in air-froth flotation practice, metallurgical and mechanical efficiency have followed somewhat divergent paths, but perhaps a by-way, connecting the two, will be suggested by the process as outlined in the preceding pages.

LIFTING MAGNETS are used successfully in recovering iron and steel objects that had been sunk in the water. Recently a Cutler-Hammer type of magnet was applied to lift 420 tons of pig-iron from a wrecked barge in the Tennessee river.

The Oil-Shale Industry

By ARTHUR J. HOSKIN

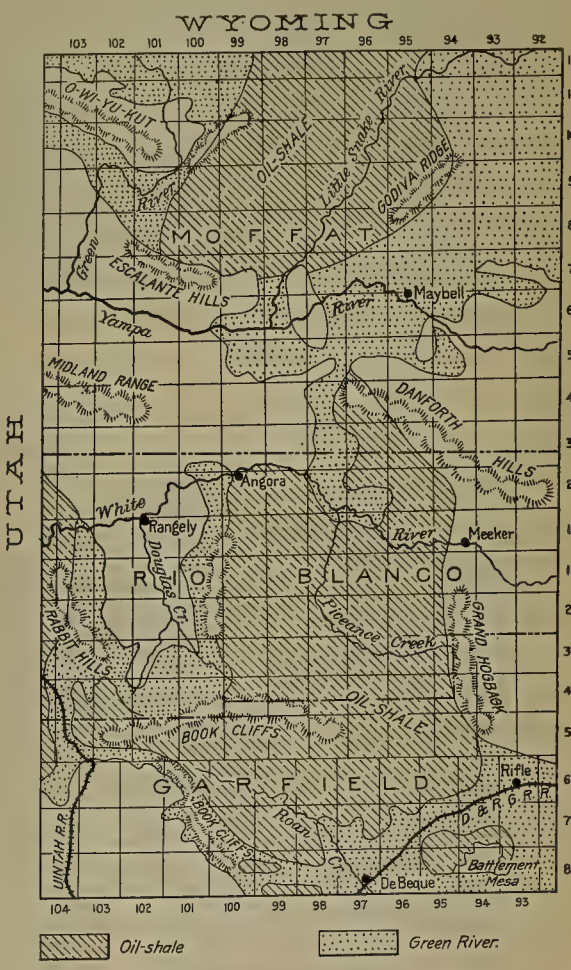
INTRODUCTION. Much is being said about an American industry in the intermountain region embracing portions of western Colorado, south-western Wyoming, eastern Utah, and a part of Nevada. Anyone living in Salt Lake City or Denver is bound to hear of the petroleum in the shale beds of the so-called Green River series. Not only are the professional promoters busy, but staid business men are becoming interested. Government experts have said so many nice things about the oil-producing character of these shales that the present state of affairs is logical.

Any conversation on this subject is bound to include some reference to the mining and treatment of such shale in Scotland, it being assumed that our American shale is analogous to the Scottish. There being no other source of information concerning the cost and system of operation, many writers of prospectuses have offered lengthy quotations from books descriptive of the Scottish oil-shale industry. Petroleum-shale has been worked successfully in Scotland, France, Germany, and New Zealand for years. American shales will doubtless be worked for centuries to come. At the same time, there may be differences just as significant in oil-bearing shales, the world over, as there are in gold ores, and, in my opinion, conclusions drawn from foreign practice should not be applied prematurely to the Rocky Mountains. We hope the Scottish methods will prove exactly suited to our needs, but we shall not know this for a fact until somebody has demonstrated it upon a commercial scale.

The greatest activity in our new industry is noted along the valley of the Grand river, on the so-called western slope of Colorado. The little towns of De Beque and Grand Valley especially feel the impetus accruing from this new development. These towns are on the main lines of the Denver & Rio Grande and Colorado Midland railroads, which, in this region, operate a joint track.

The general elevation of the productive beds is more than 7500 ft. They are in a vast prairie region, which has been largely neglected because of the inability to irrigate lands that, with the application of water, would prove fertile. Along the water-courses agriculture flourishes. Upon maps this plateau country is called Book Cliffs and Battlement Mesa, these being originally one tableland, now separated by the Grand River valley. The tops of these mesas are almost inaccessible from the riverside, the thick beds of shale having the habit of eroding into precipitous cliffs hundreds of feet high. Mt. Logan is an isolated mass that attracts particular attention from travelers by train. It is just north of De Beque.

THE GEOLOGY of this region is relatively simple. The Green River formation is the most recent of the sedimentary series. It lies, thousands of feet thick, above the Wasatch formation, and this, in turn, overlies the Mesa



COLORADO OIL-SHALE AREA

Verde formation, which is known to be coal-bearing. My description will apply particularly to the Grand Valley, but I wish the reader to remember that the oil-shale is extensive geographically and that activities will spring up, probably, wherever there is convenient access to a railroad. The Denver & Rio Grande railroad traverses

a wide expanse of shale in Utah, and the Union Pacific railroad does the same in Wyoming.

Not all the Green River formation is oil-bearing. For the most part the productive strata are relatively high in the series, in places constituting the top of the tableland. Properties now esteemed most valuable are those so situated as to include the exposure of rich beds upon the faces of cliffs. There is no dearth of such land at present, but there are other economic desiderata that will not long exist in the scramble for ground upon which to establish industrial operations. A fair supply of water seems indispensable. Another essential is accessibility by wagon-road. Roads can be constructed to any property even if they are expensive, but the supply of water is restricted. At present, the search is for thick beds of rich shale lying exposed close to creeks.

Oil-shale is ordinarily discussed in a way to leave an impression that the oil in the rock is ready for extraction. This is, in the main, erroneous. No doubt there are traces of free petroleum in the shale, but the major part of the oil that may be derived from such rock is created during the treatment to which it is subjected. In other words, these sedimentary rocks contain natural substances in proper proportions to bring about, when heated, certain chemical reactions that will produce hydrocarbons. The shale is the compacted ooze of a former fresh-water marsh or sea; it contains the remains of the vegetal and animal life that flourished in that sea. If these organic remains be subjected to heat they will produce oil that is similar, in every way, to the petroleum obtained from wells. There is no alcohol in corn, but the moonshiner knows how to get 'licker' from it; likewise there is no free oil in shale, although it is a simple matter to put some shale into a gold-miner's retort and produce oil at the gooseneck. The richness of oil-shale, then, depends upon its content of organic remains. In Scotland these substances in the shale go by the name of 'kerogen,' a maker of kerosene. This scientific fact being understood, it is permissible to speak of the shale as 'oil-bearing,' although strictly we should say 'oil-yielding.'

The shale lies nearly flat and is without faulting over large areas. The barren and the enriched strata alternate, and, whereas the thickest and the richest layers are among the most recent, there are frequently thin seams of rich shale in the lower part of the series. These thin seams do not attract attention at present.

A splendid description of these deposits is given in Bulletin 641-F of the U. S. Geological Survey; this, if not out of print, may be obtained gratis upon application at Washington or at the other distributing offices of the Survey, for example, at Denver and in San Francisco. Although the beds lie, as stated, relatively high in the present Green River formation, they probably were originally approximately in the centre of the series.

The productive strata are generally darker in color and lighter in weight that the lean ones. The richer the shale, the less is its specific gravity. The variation in kerogen content does not, however, always correspond to the color of the rock, rich shale sometimes having a brown instead of a black hue. As the many strata in the face of a cliff are viewed from a distance it is impossible to distinguish the lean from the rich. Although there are apparent differences in shade, it does not follow that the darker streaks represent the richer zones. The richest beds have become sufficiently altered by weathering to present a yellow or gray tint that closely matches the adjacent leaner strata. If, however, a prospector's pick be driven into an outcrop, the shale is quickly differentiated as to grade, because the weathering of the oil-yielding rock does not usually extend more than a fraction of an inch deep.

When one becomes familiar with these shales he learns another characteristic that can often be utilized in long-range investigations, namely, the richer the shale the better it has withstood climatic agencies, so that it often forms a slightly projecting shelf above a sheer cliff of lean rock. The productive strata in weathering do not usually create cliffs nearly as steep as do the leaner strata; consequently they generally outcrop as sloping walls above and perhaps below vertical precipices. This is held to be an economic advantage inasmuch as it will afford a foothold during quarrying operations.

Varieties of Shale. The oil-yielding shales where they outcrop exhibit two kinds of structure, known as the 'paper' and the 'massive.' The paper shale splits into thin sheets resembling leaves, whence the name Book Cliffs, whereas the massive shale, although showing primary stratification, breaks with an irregular fracture, often conchoidal. Another difference has been asserted, namely, that the paper shale contains more paraffine than the massive. This observation has yet to be confirmed. Horizontal excavations into the paper strata usually encounter the massive shale within a short distance, indicating that the papery characteristic is only a phase of weathering.

It has been found, by preliminary research, that there is a decided difference between the properties of the two kinds of shale when subjected to heat in retorts, the massive shale having a strong tendency to form a pasty mass, especially if heated rapidly, whereas the paper shale remains in separate fragments. This has led to the assumption that a process efficient with one kind may not work successfully with the other; so the question has arisen as to what process, if any, will succeed with both kinds of shale. One company has constructed a still with the intention of handling only the paper shale that outcrops abundantly upon its property. It has succeeded in treating this shale in a small retort and is planning to erect a larger plant. Some concerns are preparing to exploit the massive shale only, while others propose to mix the two kinds as they are quarried or mined.

Methods of Distillation. Much research is being devoted to the distillation of the oil-shale. Many persons are positive that the Henderson, Pumpherston, or Young & Fyfe processes, all Scottish, or slight modifications thereof, will prove the ideal treatment for American



A MOUNTAIN OF OIL-SHALE NEAR DE BEQUE, COLORADO



MT. CALLAHAN, GRAND VALLEY, COLORADO

shale. On the other hand there are those who question whether any foreign method will suffice. Anyone who has performed experiments with massive oil-shale in a closed retort will have observed the persistent tendency to caking. Some authorities are emphatic in asserting that this shale will not cake if it be heated gradually, while others claim that the admission of steam to the retort during distillation will prevent caking. It is about this very point that the entire controversy over the treatment of our American oil-shale revolves. If we accept a statement quoted from the memoirs of the Geological Survey of Scotland, to the effect that true oil-shale does not cake when heated to redness in a closed vessel, we may conclude that the Scottish shale must differ from the American shale in this significant particular.

Among the advocates of the non-caking theory are the companies that propose to install a retorting process devised by Otto Stahlman of Salt Lake City. The refining of the crude petroleum from these retorts will be done by the Wells process, developed in the Oklahoma oil-fields. The Pearse Engineering Co. of New York controls rights to a modified Scottish process that is being adapted to the Rocky Mountain shales. In its principle of operation it differs little from the foreign methods.

The main feature of all the Scottish retorts is a vertical and rather slender furnace, oblong or cylindrical in cross-section, flaring slightly downward and operated without admission of air. The upper or distillation half of each retort is constructed of steel and is heated from without, the volatile products discharging together into large pipes leading from the top to condensers. The lower portion of each retort is of brick; within this chamber the fixed carbon is burned, in the presence of steam, to generate illuminating gas and ammonia, these products representing the main revenues from the Scotch industry. The shale is fed and discharged continuously or nearly so. The retorts are arranged in batteries or 'benches' of 64 to 80 units. The petroleum, collected as a single product from the condensers, is piped into the refining departments for fractionation. Such plants are expensive, one unit of the Pumpherston retort, including its condenser, ammonia scrubber, and tanks, costing approximately $1700, and having a capacity of only four to five tons of shale per day. This cost does not include the refining. The refining plants are of the type found in petroleum districts.

L. F. Chew of Denver is experimenting with an apparatus that is a modification of a simple gas-producer. In his process, the crushed shale is fed continuously at the top of a vertical brick-lined steel retort. Heat is furnished by the combustion of the fixed carbon of the shale itself at the bottom of the furnace. The spent shale discharges continuously through a shaking grate. It is light in color in contrast with the residual shale drawn from retorts that do not consume the fixed carbon. In practically every other American process only the volatile matter is removed during distillation. In the method just described the incandescent zone extends upward from the grate about 18 inches. The volatile matter is drawn off at the top by suction and is collected as one product.

A Denver company has built a large distillation unit patterned after a McDougall roaster familiar to copper metallurgists. This machine has four distillation chambers containing revolving rakes, each compartment lying above another compartment within which heat is generated by the burning of hydrocarbon vapors injected through burners at one side, the gases of combustion escaping at the opposite side. Crushed shale passes across the decks in alternating radial directions precisely as in an ore-roaster. It is planned to derive different volatile products from each of the four distillation chambers, the temperature of the shale being raised successively at each stage. This process was developed by Messrs. Fefelle and Wingett.

Among the processes originating in Denver is one bearing the name of its inventor, J. H. Galloupe. The shale, after being crushed to one-quarter inch, is fed continuously into the upper end of an inclined (30°) steel retort through which it travels at a rate that will cause the spent shale to discharge at the lower end in about six minutes. The retort is 24 ft. long and 4 ft. wide, and has a rated capacity of 50 tons per 24 hours. In cross-section the bottom side of the retort appears as the arc of a circle struck from the centre of a longitudinal oscillating shaft placed near the top of the retort, which, in cross-section, is an inverted V. Numerous scraper-arms protrude from this shaft. As the shaft moves slowly back and forth, these arms gently but firmly move the thin layer of shale on the floor, causing it to roll or slide forward. The retort is divided, by transverse partitions, into numerous compartments, the partitions not quite reaching the floor. Heat is applied from a fire-box at the lower end of the retort, the flame and hot gases of combustion passing longitudinally beneath the retort and discharging into a flue at the upper end. Pipes lead off from each compartment to separate condensing-members. The accompanying photograph shows that the cooling was done by air. This unit had a capacity of only 15 tons daily, but the commercial units will, as said, handle 100 tons. No air is admitted to the retort.

Numerous other processes are coming into notice, but, so far as I am able to ascertain, they are either unimportant modifications of the Scotch methods or they do not possess sufficient merit to warrant critical investigation. The only process that thus far has been installed in the Colorado shale-field—as previously mentioned—is an adaptation of the Henderson. A 12-ton unit was built by Messrs. Richards and Flynn upon property about 25 miles north-west of De Beque and was operated successfully last summer and fall upon paper shale.

It will be noted that some processes simply distill the hydrocarbons from the shale as a single product that must subsequently be subjected to re-distillation just as is done with petroleum from wells. Other processes perform the initial distillation and fractionation in one stage. I have been told that there has never been one of

these that succeeded, although there have been many attempts in this direction.

Fractionation. The crude oil derived from shale may be fractionated into numberless products. Most of the companies propose to make only a few shipping products, such as gasoline, kerosene, lubricating oil, wax, and residuum. The operators who install the simple distillation methods will rely upon marketing the crude, or they must erect complete refineries in conjunction with their retorting plants. If the majority of the companies proceed upon the plan of manufacturing only crude oil, it would seem that a splendid opening is afforded for the establishment of custom refineries.

Transportation of the liquid products from the retorting-plants to the railroads will probably be done by motor-trucks with large tanks. Pipe-lines for the delivery of the gasoline and kerosene would be feasible, since all the shale-plants will be at altitudes higher than the railroads. Crude oil and residuum cannot be thus transported for the reason that they are too heavily charged with paraffine, which would freeze in the pipe.

Hydrocarbon Products. A good idea as to the petroleum contents of the shale may be obtained by reading Bulletin 641-F, already mentioned. Many individuals and companies have had tests made by professional chemists, and these tally with the results reported by the Government experts.

A run made by a prominent Denver chemist upon shale taken about 12 miles north of De Beque showed a total oil content of 46 gallons per ton, the specific gravity being 0.91, equivalent to 24°B. It is proper to remark that it has become the custom to rate oil-shales by the number of gallons of crude oil derived from one ton. Shale of the grade just cited will yield about 17½% crude oil. Upon fractional distillation, the 'crude' from this sample yielded 13.1% gasoline, 45°B., to 150°C.; 38.1% kerosene, 35°B., to 300°C.; and 47.5% residuum, 16°B., to 400°C.

A test made by a refining company in Kansas showed 48 gal. crude per ton of shale, 31.8° B., to 360° C. In re-distillation of this crude, the following was obtained: 15% benzine, 55°B., to 102°C; 10% distillate, 41.7°B., to 132°C.; 20% gas-oil, 34°B., to 194°C.; 25% heavy oil, 25.8°B., to 260°C.; 28% residuum, 18.6°B., to 360°C. This report showed the crude to contain 18.6% heavy wax or grease-stock and 25.8% wax-distillate.

An investigator at Salt Lake City tested a large sample of De Beque shale and reported a recovery of 54.25 gal. per ton. The average temperature of the charge was 525°C. The crude, upon fractionation, yielded 1.5% naphtha to 150°C.; 5% light oil to 200°C.; 16% heavy oil to 250°C.; 16% fuel-oil to 300°C.; the remainder being lubricating oil to 350°C. A laboratory in Kansas City has made many tests and sums up its findings by stating that the average shale will yield, per ton, 5 gal. gasoline, 25 gal. kerosene, 2 lb. benzol, ½ lb. cresol, 100 lb. ammonium sulphate, ¼ lb. phenol, and 10 lb. wax.

A sample of shale-oil sent to an Oklahoma refinery, upon fractionation, yielded 15% gasoline; 16% naphtha, benzine, and kerosene; 43% lubricating oil; and 10% paraffine.

From such returns we observe that the shale is variable both in total contents and in the fractions that may be made. Of course, it is not strictly proper to compare these various results, for the reason that the shales and the crude oils were probably handled quite differently by the several chemists. Differing manners of applying the heat during retorting will produce varying results from the same shale, while the splitting of the fractions at different temperatures will likewise make wide variations in the quantities of the several products. Here is a new field for the petroleum technologist.



MINING OIL-SHALE NEAR GRAND VALLEY, COLORADO

Prospective Development. There will be great activity this year in the development and equipment of oil-shale properties, but it is improbable that more than a

few enterprises will get under way on a commercial scale. This is not said in a pessimistic spirit, by any means, but because I appreciate the difficulties confronting every operator in this new industry. Since nobody thus far has operated upon a practical scale in America, we lack knowledge regarding the best methods of procedure in mining as well as in retorting. We have no standard processes generally acceptable. If all managers could feel certain that foreign methods would prove efficient, progress would be rapid. The very fact that so many persons are bringing out processes differing from the Scotch is indicative that there will be considerable experimentation. Several companies are arranging to erect working units based upon new inventions. It is unlikely that all these schemes will prove successful and therefore one may anticipate that some disappointments will be experienced by the pioneers. Men who are in the lead to the extent of risking capital deserve the highest respect from their fellows and followers. Somebody must make the start. Every one of the new schemes has been tested upon a small scale, but, as any engineer knows, this is no assurance that it will prove successful upon a commercial scale. The net result of this year's efforts will be progress in the industry. Mistakes made this year will be of incalculable benefit in guiding further advance.

Cost of Equipment. When it comes to the expense of equipment, we are compelled to guess. The first cost varies tremendously. Some of the proposed schemes call for ten times as much capital as others. Any manager is willing to pay the highest figure if thereby he can feel assured of the best apparatus and the most profitable result. It may be stated roughly that the initial cost of a 100-ton retort and refinery, including the requisite mining, crushing, grinding, and condensing equipment, will be anywhere from $50,000 to $500,000. Before one can offer estimates of cost, there should be some decision as to the proper size of such a plant. Figures have been quoted publicly for plants of a capacity of 1000 tons per day. Such a capacity is perhaps the ideal to which the companies should strive, but, in an industry as new as this, it would seem improper to build a plant to treat 1000 tons daily until we know more about the operation of the processes involved. It is advisable to make the first equipment upon a modest scale, say, of only 100 tons daily in the retorting department, with provision for expansion just as soon as we know how to adjust and operate the selected processes. The crushing and grinding department of a plant can be designed at the start to handle the proposed ultimate tonnage, which may be 1000 tons or 500 tons. Several companies have made plans for plants of 500 tons daily capacity. They propose to put in retorting units to handle only 100 tons per day and to experiment with these until the managers have learned how to operate them perfectly, when additional units can be added to bring the capacity to the 500 tons. Naturally, the cost of handling shale upon a 100-ton basis will considerably exceed the cost per ton when the ultimate capacity is attained. However, the greater operating expense will be warranted if it prevent large losses due to the premature erection of unsuccessful plants.

The equipment for mining or quarrying, at the start, will be cheap. As already explained, the shale-beds, in most instances, outcrop high above the foot of the cliff where retorting plants would logically be erected, and the formation lies almost flat. In most cases, the excavation of the 'ore' can proceed for a considerable time in open workings along the precipitous slope. Eventually, it will be necessary to drive into the hills and to secure the shale by underground methods, probably by a modification of the room-and-pillar system common in coal mining. There are a few properties in which the overburden may be stripped and the shale mined continuously by open methods. In this kind of mining there will be no hoisting or pumping. Ventilation underground will require machinery as the workings are extended. This kind of ground will drill easily by hand, but the cost can be lessened by using machines. Power for driving fans and compressors will be generated by internal-combustion engines utilizing 'home-made' fuel.

One thing that gives considerable concern to each prospective operator is the problem of getting the raw shale from the mine to the plant to be erected at the foot of the cliff. Aerial tramways are planned by two companies. Others believe they will succeed in dropping the broken shale down the steep walls of the gulches in such fashion as to render it readily recoverable by shoveling and tramming.

Costs of Operation. From the foregoing it is apparent that an estimate of the average operating cost will not be possible until a decision is reached concerning the scale of retorting, the method of excavation, the manner of lowering the shale from the mine to the plant, the processes used in distillation and refining, the number of shipping products manufactured, and the scheme for delivering these products to the railroad.

Machinery for crushing and grinding will vary, some processes requiring relatively fine grinding while others call for coarse crushing only. In some of the Scottish methods the shale is crushed only to 6-inch size, whereas in at least one American process it must be reduced to quarter-inch. Oil-shale behaves differently from ordinary shale in crushers and pulverizers, being much tougher and having a tendency to clog the machinery. All kinds of comminuting apparatus are being tested, so that it is impossible to arrive at even rough averages for the probable cost of crushing. This item of expense may vary from 7 to 35c. per ton.

There is more assurance regarding the probable cost of mining. Estimates based upon an initial output of 100 tons per 8-hour day place the cost of securing the shale from outcropping ledges at from 40 to 50c. per ton, these figures including the breaking of the rock and lowering it to the refinery-sites. When the shale is mined underground the cost may be 20c. higher per ton.

The cost of distillation has been estimated between 12 and 65c. per ton; that of condensation depends upon the number of products made and may run from 9 to 17c.

per ton of shale treated. In processes employing separate retorting and refining plants, the item of refining is important, for it may run from 25c. to $1. If by-products or materials other than ordinary gasoline, kerosene, lubricating oils, greases, and wax are to be manufactured, one must allow additional expense for the apparatus and chemicals required.

The cost of fuel will differ according to the process. One company expects to mine an extra ton of shale to be burned on grates in driving off volatile matter from four



THE CHEW APPARATUS

tons of the same shale. Others intend to conserve the fixed gases that come off first from the shale during distillation and to burn these in the fire-box. If the gases do not supply sufficient heat, they will be augmented by raw shale or possibly by coal or wood. Another suggestion is to manufacture water-gas from the residual carbon in the hot spent shale from the retorts, this gas to be mixed with the non-condensible gases coming from the retorts. In practically every instance, the operator plans to get his fuel from the shale itself.

By-products. In Scotland the quantity of crude oil retorted seldom exceeds 30 gal. per ton of shale, and it is a regular practice to treat rock yielding as little as 10 to 15 gallons. In our American shale-field nobody expects to handle shale running below 30 gal., at least for some years to come. An average grade for the shale deposits upon which activities are based in the near future would be one barrel, or 42 gal., per ton. In Scotland the yield of ammonium sulphate constitutes an important factor in the profit. It is said that where the yield of oil is low that of ammonia is high. The nitrogen content is therefore of more significance in Scottish works than the kerogen. To the American way of thinking, it appears that the Scottish profit is dependent largely upon the by-product from the oil-recovery.

American oil-shales invariably yield ammonia upon distillation, and it is probable that every company will contrive to make a commercial product from this variable chemical. Various investigators have reported other by-products, such as potash, gold, silver, and even platinum,



THE FLYNN & RICHARDS RETORT

in addition to such things as phenol, benzol, cresol, ozokerite, and dye-stuffs. Some of these substances may be recovered from the shale at a profit under prevailing market-prices, but there is doubt regarding the commercial outlook after the War. The spent shale will average 1% K_2O, too little to warrant the necessary expenditure for recovering potash, even at current prices. As to the precious metals, I am skeptical and suggest that samples have been salted unintentionally in the laboratories. A few cents per ton of shale handled might be received from the sale of benzol, cresol, and phenol, but the profit might prove a negative quantity. If it really prove possible to manufacture 10 lb. of ozokerite per ton of shale, as one chemist claims, this single item would offer greater returns than all the other products combined.

In the domestic industry, plans are laid primarily to make but a few primary products, such as motor-spirit, fuel-oil, lubricating oil, and residuum, for all of which

there will continue a steady demand indefinitely. Managers will, no doubt, be awake to the potentialities in by-products and will, in the course of time, make preparations to manufacture such of them as offer a profit.

Property Rights. It is necessary to make some mention of the legislative troubles confronting future locators of oil-shale land. Up to the present, this kind of land has been located under the ordinary oil-placer regulations, claims being usually of 160 acres each, in the names of eight persons. Bills are pending in Congress looking to future restrictions in the location of all kinds of oil-yielding land. It is likely that Congress will place all non-located oil-shale land in the same general class with ordinary petroleum land, so that future locations will be governed by the same regulations as to acreage and lease royalties as will apply to oil-lands.

A Manufacturing Industry. The operation of an oil-shale plant is a manufacturing proposition. The supply of raw material is abundant and plants can be designed for long service. There is little or no speculation regarding the grade of the raw material because the beds continue reasonably uniform in their content of kerogen over considerable distances. The markets for the products will remain strong for years to come. The supply of motor-fuels, derived from petroleum wells, has been falling steadily behind the needs of the world at large. The uncertainties confronting this industry are primarily in the selection of suitable schemes of treatment, but these will be settled before long by those that have the nerve to make the first moves in the erection of commercial plants.

There is one feature of this business that has not been sufficiently recognized. This is the necessity of placing the technical and practical affairs of the business in the hands of men properly qualified. The remark is often made that we have, in America, too few experts in this line, and this is literally true. At the same time, we have plenty of engineers that have had sufficient experience in branches not widely different from this new business to have given them the foresight and judgment needed for avoiding serious blunders. It is stupid to risk capital in projects that are to be managed by laymen who assume they are capable of handling this business at least as well as a trained engineer. Even with the best available technical advice, companies may experience difficulties at first, but such troubles will be vastly less costly than those to be faced by shortsighted operators unwilling to employ engineers. On the other hand, investors must be on their guard against numerous shysters that pose as experts. The activities of such persons are apparent already.

X-ray photographs may be used to determine the internal condition and deterioration of reinforced concrete. Photographs of slabs several inches thick have shown the condition of the concrete and also of the reinforcing-rods. The injection of a bismuth solution under pressure helps to determine the existence and position of even fine cracks.

Chromite in North Carolina

By JOSEPH HYDE PRATT

*The occurence of chromite is in the peridotites and allied igneous basic magnesian rocks, or in serpentines that have resulted from their alteration.

The mining of chromite has been attended with uncertainty on account of the pockety nature of the deposits, for chromite is not found in veins, but in pockets or bunches of varying dimensions, which may or may not be connected with one another, and are limited in extent. The fact that 10 tons or 10,000 tons have been taken from one pocket does not signify that it is still a good deposit, but if a certain pocket has been largely productive, that would serve as a strong indication of the existence of other pockets nearby. Again, if a deposit of this mineral is found near the contact of peridotite with other country rock, and if this peridotite is extensive and the chromite is found in considerable quantity, there is a probability that large deposits will persist in the area.

While chromite is almost universally associated with the peridotites of North Carolina, only in a few localities is it found in quantity. One of the most promising deposits is in Yancey county at Mine Hill, five miles north of Burnsville, the county-seat. The ore is in peridotite, which outcrops on both sides of the road. The work done gives indication that chromite occurs in quantity. The C. C. & O. railroad from Erwin, Tennessee, to Green River station, North Carolina, runs within 3½ miles of the property. A 52% ore can probably be obtained by hand-picking. Associated with the large peridotite area in the vicinity of Webster, Jackson county, chromite has been found abundantly near the contact. It is not proved whether it is to be found in sufficient quantity to make mining profitable. These deposits are from three to five miles from the railroad. Another property is being developed on Big Ivey creek, in Buncombe county, about 16 miles north-west of Asheville and nine miles from the railroad. There is considerable chrome sand on the property, which is readily concentrated, and the concentrate is said to contain 54.09% chromic oxide. The cobbed ore analyzed 48.78% chromic oxide. A promising deposit of chromite occurs in the Balsam Gap peridotite area on both sides of Dark Ridge creek about 175 yards south of the Murphy branch of the Southern railroad. A number of open cuts and pits show the presence of chromite. There is a large quantity of float-ore in the vicinity. All the North Carolinian ores are high in grade. The existence of large deposits has not been conclusively shown, but the four localities mentioned are worthy of investigation.

Credits to the Allies totaled $4,949,400,000 to March 1918. Of this, England received $2,520,000,000; France, $1,440,000,000; Italy, $550,000,000; and Russia, $325,000,000.

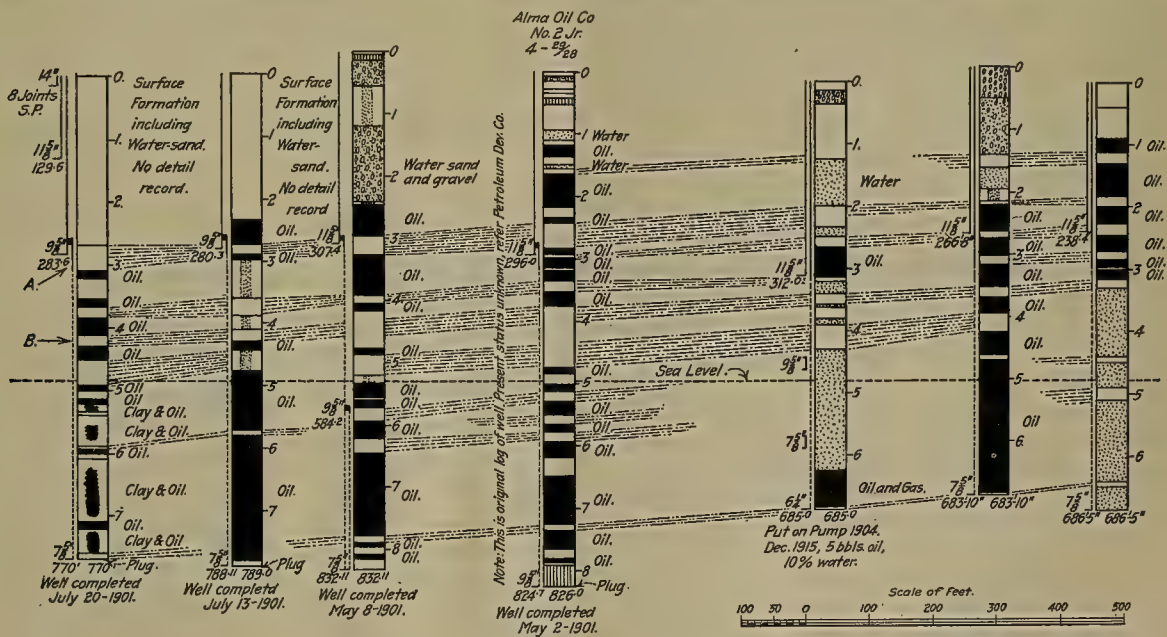
*Abstract: 'Manufacturers Record.'

Reduction of Water-Infiltration in Oil-Wells

By R. P. McLAUGHLIN

The value and necessity of high-class technical work in the development of oil lands has been demonstrated by the California State Mining Bureau during the past two years. The law in effect since 1915 gives the Bureau authority to make investigations of underground conditions at oil-wells, and to enforce its decisions. Provision is also made in the statute that the officials in charge of the work shall be engineers or geologists experienced in the development and production of petroleum. The authors of the law insisted on this latter provision as being a prime necessity upon which all specifications, inspections, and penal actions must rest. There was considerable skepticism as to the value of the so-called 'theoretical' work, but repeated demonstrations have convinced open-minded observers that the natural laws of physics and geology apply to oil deposits and that a recognition of these laws is advisable.

For the past fifteen years the Kern River oilfield has commonly been considered as a difficult field of operation. Wells were frequently abandoned as unprofitable on account of the large amount of water that was produced to the exclusion of oil. When wells were not abandoned, expensive machinery, such as air-compressors, had to be employed for lifting the water. Systematic efforts were not made to prevent the water from entering the wells, and consequently the profits from the field have been reduced. Properties of the Associated Oil Co., the Atchison, Topeka & Santa Fe Railway Co., and the Alma Oil Co., in section 4, T. 29 S., R. 28 E., M. D. B. and M., had for many years been affected by water. Several expensive compressor-plants were operated continuously, at at cost of about $500 per month, besides consuming about 100 bbl. of oil per day for fuel. The three companies voluntarily submitted their problem to the State Mining Bureau, and two members of the engineering staff, R. N. Ferguson and G. McGregor, were assigned to make the investigation. Considerable time was devoted to gathering all available statements as to the past and present condition of the various wells. In many cases the information was fragmentary, and the opinions of interested parties were flatly contradictory. Detailed cross-sections were drawn to graphically present this information, both geological and mechanical, as to the various wells. A complete report was furnished to the interested parties, setting forth all the evidence and giving the conclusions of the investigators. Definite recommendations for repair work at certain wells were made. The conclusions were that the water came from two main sources, namely, both from below the productive oil-measures and from above them. The report stated that the 'bottom' water was giving the most trouble, and that it was entering the oil-sands through a few wells which had been drilled too deep. It stated furthermore that 'top' water was also giving trouble, and that this was be-



CROSS-SECTION SHOWING LOGS OF SOME OF THE AFFECTED WELLS

cause no uniform plan for its exclusion had been followed when the wells were drilled. It was recommended that a campaign of repair be followed, commencing with the plugging of the bottom of two wells, which were probably too deep and therefore causing the main trouble. It was pointed out that if this first step failed to remedy conditions, work at other wells would be required in order to control the 'top' water.

The owners of the two deep wells commenced work as recommended. One of the wells (Alma Jr. No. 2) has been pumped by compressed air for a number of years. It produced about 12,000 bbl. of water per day, with no oil. As soon as repairs began at this well, the air-lines had to be removed. The water-level rose immediately in surrounding wells, which thereupon ceased to produce oil. This made it necessary that the proposed repairs should be made as rapidly as possible. To expedite matters, J. E. Beard, president of the Alma Oil Co., arranged that the State Oil and Gas Supervisor should assume the responsibility of choosing a crew of workmen and of directing the work. A crew from the adjoining Santa Fe property was engaged, and with the co-operation of D. T. Saine, superintendent for the latter concern, repairs proceeded successfully. It is of particular importance to note that several years ago a similar co-operative agreement between the companies had been made, but the efforts to repair the well were unsuccessful at that time.

No new mechanical methods were adopted by the State Mining Bureau in repairing the well, but it was impressed upon all interested parties that the job was difficult and would not be abandoned, no matter how slow the progress might be. It was recognized that the upward flow of water through about 100 ft. of loose unconsolidated sand could not be stopped until a plug was placed below the sand and in the impervious clay-stratum overlying the water-bearing sand. Such conditions held out no promise of speedy work. The old perforated casing was removed from the well and unperforated 7⅝-in. casing was inserted until it was stopped by the heaving and caving sand at a depth of 702 ft. The casing was carried through the loose sand to a depth of 789 ft. by introducing sufficient clay to fill the interstices of the sand and thus prevent further caving of the sides of the hole. This took about four months and required 1000 cu. yd. of clay. The casing could not be carried deeper than 789 ft., but the continued use of mud permitted the hole to be cleared to a depth of 886 ft., proving that the original log shown in the cross-section was in error to the extent of 60 ft. This required 100 cu. yd. of clay in addition to the amount already used. The clay was shoveled into the top of the casing and a steady stream of water was also kept running into the well. The tools were kept swinging at the bottom of the open hole, mixing the mud and assisting the water to carry it into the loose sand. The casing had to be raised and lowered to keep it free. A system of mixing the mud at the surface and pumping it into the hole would have been quicker, but the necessary equipment was not available.

Within a week after mud was started into the well, it began to show in the fluid pumped from surrounding wells, as much as a quarter of a mile away, both up and down the dip of the strata. As fast as neighboring wells showed mud, they were shut-down, so that the mud would not be drawn away unnecessarily from the well under rapair. The well was plugged between depths of 886 and 702 ft. The plugging was done by stages from the bottom. The general plan was to 'shoot' away the casing in impervious clay streaks and to place solid cement plugs. Between the clay streaks the casing was not 'shot' ordinarily. Instead a filling of clay, cobbles, and rope was tamped into the hole. Each cement plug required from 10 to 15 sacks of cement. Five 'shots' of 30 to 50 lb. of 60% dynamite each were exploded. A heaving-plug was set in the casing at a depth of 702 ft., and the casing was perforated between 684 and 702 feet.

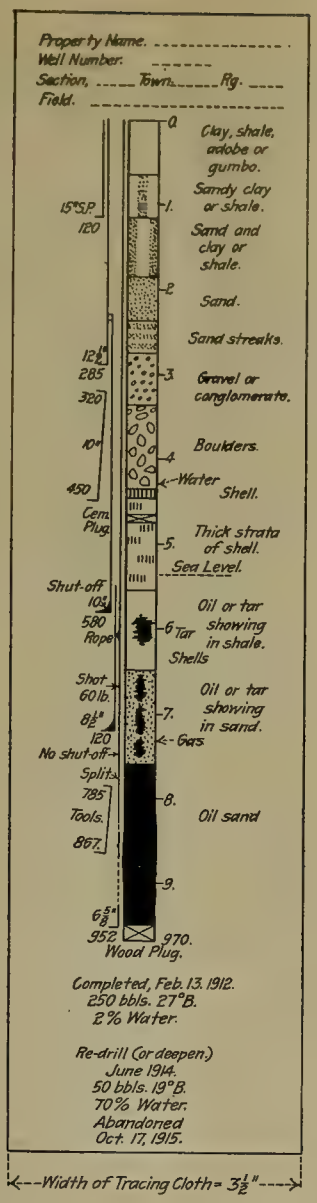
The total cost of the work was as follows:

Labor (March 1 to September 17)	$4,444.48
Lumber	180.05
Material, miscellaneous	562.40
General expense	231.20
Hauling clay	2,499.14
	$7,917.27

The condition of wells in the vicinity, both before and since repairs, is shown by the following table:

	Before repairs		After repairs	
No.	Oil bbl.	Water bbl.	Oil bbl.	Water bbl.
Alma Jr.				
1	trace	150	7	00
2	00	12,000	trace	100
5	trace	200	10	trace
11	"	250	7	40
12	"	200	10	25
1	3	32	4	10
Petroleum Development Co. (Santa Fe)				
2	00	1,440	(not yet rigged for pumping)	
6	5	250	4	20
10	5	400	5	10
14	5	5	5	10
18	7	1,000	7	25
Total	25	15,927	59	240

The saving in operating expense and fuel at the compressor-plants, plus the increased production from affected wells, amounts to about $150 per day, which is a yearly profit of nearly 700% on the expenditure for repairs. The profit would have been much greater had the well been repaired at first before the compressor-plants were built. It may surprise the average reader, holding the common belief that large oil companies are highly efficient, to learn that comparatively few concerns take full advantage of technical knowledge. The State Mining Bureau has, during the past year, called the attention of all concerns having an annual oil production of more than a million barrels to the advantage and



Well Logs

Formations as shown on typical drawing; condition and color of same by word (abbreviated)

Cement as shown on 10-in. and 8¼-in. casings.

Formation shut-off as on 12½-in. and S.P. casings.

Perforations as on 6⅝-in casing.

Adapter, as shown between 10-in and 12½-in casings.

Packer, as shown between 8¼"in. and 6⅝-in. casings, noting the kind (rope or mechanical.)

Casing cut and pulled, as on 8¼-in. and 10-in. casings.

Casing or tools sidetracked, as shown at left.

Casing shot, collapsed, split, or otherwise altered, should be noted on left margin, also any information as to success or failure of shut-off.

All special geologic features, such as gas, tar, water, fossils, and formations, and their colors, should be noted to the right of the log.

The kind of plugs, (cement, wood, or other) must be noted, as shown at left, and bottom.

STANDARD FORM FOR OIL-WELL LOGS USED BY CALIFORNIA STATE MINING BUREAU

economy of thoroughly organized technical staffs authorized to direct their development work. A gratifying improvement has been noted, but some companies do not yet realize the importance of this matter. The public has always been concerned in the protection of our oilfields, and at present the war-time needs make it obligatory that the utmost efforts toward economy of labor and material be exerted. The next annual report of the State Oil and Gas Supervisor will therefore classify all the large producers with reference to their technical organization. The law makes it mandatory for the State Mining Bureau to approve specifications and inspect all work at new wells, and it is therefore impossible immediately to investigate and solve the many old problems similar to the one herein described. There remains in the oil business a broad field of usefulness for competent engineers engaged in private practice or in the regular employ of oil companies.



STREAM OF WATER PUMPED FROM ONE OF THE AFFECTED WELLS BEFORE REMEDIAL WORK WAS DONE

According to a preliminary report issued by the U. S. Bureau of the Census, American-owned merchant vessels of five tons net register or over, of all classes, operating during the year 1916 on the coast or inland waters of the United States, including Alaska, or between ports of the United States and foreign countries, numbered 37,894 and had a total gross tonnage of 12,250,000. Gross tonnage is calculated by dividing entire internal capacity, in cubic feet, by 100. The geographical distribution of this gross tonnage was as follows: Atlantic Coast and Gulf of Mexico, 6,509,000; Mississippi river and its tributaries, 1,621,000; Pacific Coast, including Alaska, 1,186,000; Great Lakes and St. Lawrence river, 2,738,000; canals and other inland waters, 196,000. The distribution according to method of propulsion was: Steam and other power, 6,098,000; sail, 1,089,000; unrigged, 5,063,000. The increase in vessels compared to 1906 was only 1½%, and the gross tonnage shows a decrease amounting to 5%. This is caused by the marked reduction in number and tonnage of sailing vessels and in tonnage of unrigged craft. The former show a decrease in number from 7131 to 2979, or 58%, and in gross tonnage from 1,704,000 to 1,089,000, or 36%.

Gold output of Rand in February was 659,000 oz., compared with 721,000 oz. a year ago.

Roasting Zinc Ore for Leaching

By FLOYD DIXIE JAMES

*Zinc sulphide ore is roasted to convert the zinc into the oxide or sulphate so that it can be dissolved in dilute sulphuric-acid solution. There are two schemes available: (1) an oxidizing roast, and (2) a sulphatizing roast. The object of the oxidizing roast is to completely eliminate the sulphur, the zinc remaining as oxide. The object of the sulphatizing roast is to oxidize the zinc entirely to sulphate. Zinc oxide is readily soluble in sulphuric-acid solution, and zinc sulphate is soluble in water. In the early work on the hydrometallurgy of zinc, the sulphatizing roast was tried, because the zinc sulphate formed was soluble in water, but great difficulty was experienced in converting all of the zinc to the sulphate, and the recovery was low. The existing commercial plants appear to have started to effect a complete de-sulphurization or 'dead roast', that is, to convert all of the zinc to zinc oxide. This has always been the aim of the retort smelters, so that information and data are readily obtainable along this line. The processes now in use seem to have been based on the application of the oxidizing roast, because the metallurgists could figure on the results to be expected from it. As the plants are giving the anticipated results, their metallurgists are experimenting with the sulphatizing roast, as this would lower the cost of treatment, and materially lessen the acid-consumption per pound of zinc.

Regardless of which roasted product may be desired, the complete elimination of sulphide-sulphur is essential. Zinc sulphide is practically insoluble in dilute sulphuric-acid solutions, and each pound of sulphur, present as sulphide in combination with zinc, renders two pounds of zinc insoluble.

Care must be used in eliminating it, for at elevated temperatures zinc ferrite is said to form. Zinc ferrite causes no difficulties in retort-smelting, as it requires only a little extra heat to decompose it, but in hydrometallurgical processes it may prove fatal, because, being insoluble in dilute acids, it causes a large loss of zinc. Some metallurgists assert that zinc ferrite forms at a low temperature, and they regulate the roasting temperature accordingly, while others assert that high temperature is required to form it.

The length of time that the ore is roasted is important as well as the temperature. The longer and harder an ore is roasted the denser will be the resulting product, on account of the molecular stresses which are set up. The physical condition of the ore plays an important part in the ease of solubility of the zinc from the roasted ore. This may increase the time of leaching, or it may cause a lower recovery, for some of the zinc may have been rendered insoluble. One writer† gives zinc ferrite as 20% soluble in cold 10% sulphuric acid. W. McA. Johnson‡ says that, by heating zinc ferrite at 1300° C. for 12 hours, he obtained a hard dense zinc ferrite, which was practically inert chemically. The ferrite used by the former writer could not have been so strongly ignited.

It is known that ignition renders zinc oxides less easily soluble in caustic solution, and time and temperature play a large part in the degree of solubility. This should also hold for other solvents. Therefore, when roasting for hydrometallurgical purposes, the temperature apparently should be held as low as is consistent with good work, and the roasting should be as rapid as possible. The conclusion from this is that the possibility of forming zinc ferrite is not the only reason for the careful regulation of the conditions of roasting. The present tendency toward the sulphate roast makes it beneficial to have iron in the ore, as it is difficult to obtain a good sulphate-roast on a blende that is low in iron. While the iron aids in sulphate roasting, it also makes the production of zinc ferrite possible, unless the temperature can be controlled to prevent it. Such control of the conditions of roasting as will produce a maximum of zinc sulphate, and at the same time avoid an excessive formation of zinc ferrite, or leave zinc sulphide unoxidized, will admit of treating any of the low-grade complex ores successfully. In my experiments I finished some of the roasting tests at a high temperature to bake the iron and to render it insoluble in dilute sulphuric acid. This was easily done; but as some of the zinc apparently was rendered insoluble, and as it was found that a considerable quantity of ferric iron was not harmful in electrolysis, this method was abandoned. A small amount of iron is necessary in the solution during purification to remove the arsenic and antimony. It is more effective if it is dissolved from the ore than if produced by throwing in scrap.

The practice of using carbon to aid de-sulphurization in the roasting-furnace does not appear to have a place in roasting for subsequent leaching. The carbon, at the low temperature of a roaster, will decompose zinc sulphate according to the equation:

$$ZnSO_4 + C = ZnO + SO_2 + CO$$

This would defeat the purpose, as a maximum amount of zinc sulphate is desired. The effect of carbon on zinc ferrite at the temperature of the roaster I do not know.

*Abstract: 'The Hydrometallurgy and Electrolytic Precipitation of Zinc'; Bulletin Missouri School of Mines and Metallurgy, 1917.

†Wells: 'The Ferrites, Compounds of an Iron Acid'. 'E. & M. J.,' August 29, 1908.

‡'The Rôle That Zinc Ferrites Play in Hydrometallurgy'. 'Met. & Chem. Eng.', January 1913.

Coal added to an ore which had been roasted to a low-sulphur content gave a roasted product which yielded a better recovery by leaching than an ore not treated with coal. When the loss of zinc in roasting was investigated, the ore to which coal had been added showed a loss about three times as great as in the regular roast. The gain in recovery on leaching was slight.

Leaching of the Ore. The idea was to determine the maximum percentage of zinc that could be leached under the most favorable conditions. The recoveries obtained show what is possible under ideal rather than commercial conditions. Whether or not these can be duplicated on a commercial scale, I cannot say, but under favorable conditions they should be. The exact amount of acid solution was calculated and added. After the ore and solution had been agitated a sufficient length of time the solution was filtered from the residue. Dilute sulphuric-acid solutions were used for all the leaching tests. After solutions of various strengths had been tried, it was decided that 10% was best, as it gave the zinc concentration desired for the electrolytic cells, and decreased the bulk of solution to be handled. A more dilute solution gave the same recovery, but it had the disadvantage of producing an electrolyte low in zinc and a large volume to be handled. Very little work was done with stronger solutions, as they did not give promising results.

In the first series the agitation was continued for 24 hours. The idea was to extract all the zinc possible. The time given was found to be in excess of that required. The ore was ground to pass a 100-mesh screen. It was thought that at 100 mesh all the soluble zinc would be exposed to the action of the acid. The results of the leaching on finely ground calcine and that on the calcine as it came from the roaster did not show much difference in extraction. The ore appeared to have been rendered porous enough by roasting so that the acid could penetrate it and extract all the soluble zinc.

Purification of the Solution. The most important step in the electrolytic-zinc process appears to be the purification of the solution. Until recently all of the processes in vogue attempted to deposit the zinc from impure solutions, and were failures. Now, however, by using practically the same process, but purifying the solution before electrolysis, favorable results have been attained and large successful plants are in operation. It appears that an exceedingly pure solution is essential for success. The presence of some impurities, even in small proportions, will not only give an impure deposit of metal, but will prevent the deposition of zinc in a smooth coherent cathode. The solution from the leached calcine may contain the following impurities: arsenic, antimony, iron, manganese, copper, and cadmium, together with others of less importance.

The iron is the first impurity to be removed. It is present mainly in the ferrous state, and must be oxidized to the ferric condition so that it may be precipitated and removed as ferric hydroxide. Various oxidizing agents can be used. Manganese di-oxide is generally added to oxidize the iron. The oxidation takes place according to the following reaction:

$$2FeSO_4 + MnO_2 + 2H_2SO_4 = Fe_2(SO_4)_3 + MnSO_4 + 2H_2O$$

The free acid in the solution must be neutralized before the iron can be precipitated as the hydroxide. Limestone, milk of lime, high-grade roasted zinc ore, or zinc oxide can be used to neutralize the free acid and precipitate the iron. The method of leaching can be so arranged as to run the solution through a fresh charge of ore. This will use up the free acid, while the ferric hydroxide will be precipitated from the solution when it becomes slightly alkaline. When milk of lime is used the following reaction takes place:

$$3Fe_2(SO_4)_3 + 9Ca(OH)_2 + 2H_2O = 6Fe(OH)_3 + 9CaSO_4{\cdot}2H_2O$$

The insoluble ferric hydroxide is precipitated, and carries with it the arsenic and antimony present, the freshly precipitated ferric hydroxide forming an insoluble compound with arsenic oxide. The antimony behaves in a similar manner. The solution contains copper, cadmium, and other metals, and these are removed with some form of metallic zinc. Some of the metals are replaced by zinc as shown by the following reactions:

$$Zn + CuSO_4 = Cu + ZnSO_4$$
$$Zn + CdSO_4 = Cd + ZnSO_4$$

The filtered solution should be sufficiently pure for use in the electrolytic cells. In my tests the procedure was as follows: The iron was oxidized in three ways: (1) By forcing air through the solution; (2) by passing ozone through the solution; (3) by addition of manganese di-oxide. In the first method compressed air was passed through the solution for some time, and the remainder of the purification carried out in the regular manner. In the second, ozone was passed through the solution slowly. Considerable difficulty was experienced in handling the ozone. The machine was rather small and the work was done under difficulties. The results cannot be taken as final. Ozone is a cheap and efficient oxidizing agent, and when properly applied, it seems that it should prove the cheapest and most effective method of oxidizing the iron in solutions that are free from manganese. In the third method manganese di-oxide was added to the solution and thoroughly agitated with compressed air. This gave very satisfactory results.

The solution was filtered, and the copper, cadmium, and other metals were precipitated from the solution by means of zinc-dust, which was added to the solution and thoroughly agitated. Better results were obtained when the solution was allowed to drop slowly through a filter containing zinc-dust. It is thought that this was due to the greater length of time that the solution was in contact with the zinc. Zinc-scrap and shaving have been used to remove copper, and other metals, but zinc-dust has been found to be the most speedy and efficient reagent for this purpose. The solution was then filtered to remove the excess zinc-dust and the metals which had been thrown out of solution. This filtered solution should be pure enough for the electrolytic cells.

Source of Nitrate and Iodine

By A. W. ALLEN

Chile produces two substances having strangely contrasting utility: nitrate of soda, used for making munitions, and iodine, the base of iodoform, which is perhaps the best known wound-healing antiseptic. They are found together in one of Nature's greatest chemical storehouses, the Atacama desert. Of the two the nitrate is more widely employed, for in times of peace it is used extensively as a fertilizer and also in sulphuric-acid manufacture. In the period of reconstruction that will follow the War it will play an important part in giving renewed impetus to agriculture.

The deposits of the raw material, constituting Chile's most valuable asset, and yielding her an immense revenue, have caused war and have aided war. Provocative action on Bolivia's part in 1879, interpreted as an interference with Chilean interests at Antofagasta, then a Bolivian town, led to a severance of diplomatic relations. In the war that ensued Peru joined Bolivia against Chile, but Peru ultimately lost the province of Tarapacá, and Bolivia lost her only seaport. Chile gained an immense territory containing about 500 square miles of nitrate deposits. The nitrate pampa, as the desert is called, has no rival for desolate dreariness. It never rains and all the lines of erosion are always dry. Of vegetable or animal life there is nothing to be seen; but the pampa's desolation and monotonously dry climate is its salvation, because a single shower of rain would play havoc, and the world's principal deposit of nitrate would be quickly lost by seepage into a waste of worthless sand. Many theories have been advanced to account for the deposit. Some maintain that it has been caused by the action of bacteria; others that original deposits of guano or sea-weed have been subjected to the decomposing action of salt water during a subsequent submergence under the sea. It is doubtful whether any unanimously acceptable theory will ever be advanced. The fact remains, however, that this huge deposit is estimated to contain about 250,000,000 tons of sodium nitrate and about 250,000 tons of iodine. This supply is enough to make munitions and antiseptics, even at the present rate of consumption, for another century. The nitrate and iodine-bearing rock or 'caliche' is found in horizontal layers a foot or more in thickness, often on the very surface, but usually at a depth varying from 5 to 30 ft. It commonly occurs in the form of a brick-red stone, somewhat resembling granite, and often sparkling with crystals of nitrate, but other colors are also seen. The 'caliche,' as it is called, is exceedingly friable, and falls to pieces after prolonged exposure to the air. If taken outside its native habitat, it absorbs moisture with great avidity and 'weeps' its soluble contents.

Methods for the recovery of the nitrate usually follow conservative old-fashioned lines, but recent research is pointing the way to more economical methods. The broken caliche is 'cooked' in large vats, and the clarified liquor distributed to shallow 'bateas,' where the nitrate is allowed to crystallize. The iodine is then recovered from the remaining 'mother liquor' by means of a precipitant made from native sulphur and coal.

Over a hundred nitrate plants are in operation, the larger number having a normal capacity of about 800 tons of caliche per day. Over narrow-gauge service-



NITRATE AND IODINE WORKS, CHILE

railroads life pulsates through the mummified landscape; a never-ending stream of oil-tanks and supply trains goes from the coast to the pampa region; and platform cars stacked with nitrate returns from the pampa to the coast. "It all goes to the Germans," said a well-known Mejillones wit to me; and then, seeing that the jest had not miscarried, he added, "but in a form they don't like." This may not be strictly true, because some of Germany's 'neutral' neighbors imported largely increased amounts of nitrate at the outbreak of war, ostensibly for agricultural purposes, but at a rate suggesting the advisability of putting the crops on rations to prevent over-indulgence in fixed nitrogen.

After an apparent realization of the existing conditions of supply in the United States an appropriation of $20,000,000 was voted by Congress over a year ago to provide a plant to extract nitrogen from the air. The scheme, for reasons not hard to understand, was long blocked by certain chemists and others who tried to have the money diverted from its intended purpose to experimental investigations. Entire dependence on Chile for nitrate is still the sad case of this country and is likely to remain so for some time to come.



NEW YORK

Employment and Labor; Co-operation and Benefits.

The New York Section of the American Institute of Mining Engineers met at the Engineers Club on March 26 and discussed labor and employment problems. Sidney Jennings, president of the Institute, and one of the vice-presidents of the U. S. Smelting, Refining & Mining Co., outlined the evolution of company laws from the inception of the idea in early Roman times, cited the drastic anti-company legislation passed during periods of mediaeval and modern English history, and discussed the application of the principles involved at the present date. It was pointed out that the immense growth of centralized business has tended to estrange personal co-operation between employer and employee. Operations are now carried out on so vast a scale that the manager or superintendent of a property or works may know personally very few of the men on his payroll. This has led to a lack of understanding. A plea was made for the better utilization of prominent trades-union leaders in the handling of employment problems by large concerns; and the appointment of an employment agent or manager to engage and discharge all employees, and so minimize the effect of personal friction and misunderstanding between the latter and their shift-bosses. J. Parke Channing, of the Miami Copper Co., compared labor conditions here and in England, and dwelt on the difficulty of the foreign labor problem in the United States—a complex phase of the situation not encountered in England. Attention was directed to the post-bellum reconstruction policy of the British Labor party in its tentative demands for (1) a national minimum wage, (2) the democratic control of all industry, and (3) the re-modeling of national finance so that all excess wealth could be utilized for the common good. These demands indicate the temper of the masses and, although a modification of the terms may be expected, the fundamental ideas will doubtless find repetition among the same section of the community in the United States. Trades unionism is little understood, and it is inadvisable to ignore the obvious fact that the claims and interests of employers and employee are usually diametrically opposed. Compromise might help to reach an understanding, but education is imperatively necessary on both sides. The human phase of engineering should form a part of every educational curriculum to train men for positions of responsibility. Walter Douglas, of the Phelps-Dodge Corporation, dwelt at length on the efforts being made, especially at the Copper Queen property, to attract and retain labor by means of material and monetary advantages. A service bonus of $100 is paid to all employees after they have been in the company's service for over a year. A pension amounting to 2% of all wages earned is paid after 15 years' service, or if retirement is necessary on account of physical incapacity. Workers may retire at 60 and claim the same privilege. The maximum amount payable under the scheme is $1000. The cost of living at Bisbee has been reduced by well-organized and efficiently-managed company stores. Hospital dues amount to only $2 per month as a maximum expense to cover all possible medical attention for a married man, his wife, and children. Unions are recognized by the authorities, but no possible excuse is accepted for disloyalty to the Government or repudiation of a contract when once entered into. Grievances which cannot be amicably settled at the mine are taken to a Federal Mediator. Edwin Ludlow, vice-president of the Lehigh Coal & Navigation Co., dealt largely with the position of labor in the anthracite coal region of Pennsylvania during the past 15 years. Serious labor troubles in 1902 led to the appointment of what was known as the Anthracite Strike Commission, whose findings have materially aided industrial peace and a better understanding between employer and employee since that date. Failing a settlement of the dispute on the property it was agreed that the matter should be laid before a Board of Conciliation, which was empowered to grant or refuse the request. If the Board considered the request equitable it was granted; if unreasonable, it was refused. This excellent provision eliminated the unnecessary discussion which inevitably follows all attempts at bargaining; and indicated that the more moderate the demand the greater likelihood of its acceptance. A second salutary condition was insisted upon in that no grievance could be considered, much less remedied, as long as the men did not return to work. The objection to this on the part of employees that the findings of the Board might be delayed unreasonably was effectively met by a counter-proposition on the part of the employers that all awards would be retro-active, and would date from the time that the complaint or grievance was lodged. The result of these eminently satisfactory conditions is that the anthracite field is now able to meet labor troubles with confidence as to an ultimate solution acceptable to both parties. Of the 150,000 workers in the region, all nationalities are represented except Orientals, and these would be welcomed. The better class of workmen are encouraged to join the unions, as it is found that their influence tends to moderate or allay the socialistic opinions of the more radical and less responsible element. The I. W. W. have now no hold on the district, and would receive no welcome if they returned.

A wage increase of 15% among day laborers in its plants has been decided by the U. S. Steel Corporation, as announced in the annual report for 1917, recently published. The extra pay provision goes into effect on April 15 next; it will absorb a total extra expenditure of $45,000,000 per annum; and will increase the wage of 200,000 employees who will then receive an average of $3.69, compared with $2 two years ago. About 25% of all the Corporation's employees, including practically all underground men, work on an 8-hour basis, but this provision is not to be extended to the laborers with less strenuous duties. A shortage of labor was experienced, notwithstanding the fact that the Corporation employed 15,300 more than during the previous year. The total average number of employees amounted to 268,058, absorbing a payroll amounting in the aggregate to $347,370,400; or an average wage per day of $4.16. Welfare work received considerable attention, and it is interesting to note that sufficient encouragement was given to employees resulting in the planting of no less than 15,765 vegetable gardens on idle land in the vicinity of the works, covering an area of 2082 acres. Provision for the inculcation of the safety-first idea and the prevention and relief of accidents accounted for over $4,000,000 during the year.

The benefits likely to arise as a result of friendly intercourse between workers and officials has been recognized to an unusual extent by the Standard Oil Co. Regular dinners have been arranged to take place at the New York office of the company where a few workmen, selected by the vote of their fellows, will share the salt with the chairman, president, and other high officials. At the first reunion it was announced that John D. Rockefeller Sr. had donated $50,000 of stock and $100,000 cash for Y. M. C. A. expansion; and that a 10% increase in pay to all wage-earners, except bricklayers and watchmen, who will benefit to the extent of an additional 5% only, and lead-burners who have already received a rise, will take immediate effect. This will apply to nearly 30,000 employees. This increase makes a total increment in individual wages paid by this company recently of 98% in the case of non-skilled, and 79% in all classes. It will cost about $3,000,000 per annum. In addition, arrangements have been made with the Equitable Life Assurance Society and all employees, without cost to themselves, will be given a life assurance policy after one year's service, which may be continued in force after the employee has left the service of the company by the payment of the annual premiums. While in the company's service all charges are met by the company. Death benefits under these policies vary with the length of service from an equivalent of three months pay to a maximum of $2000. Annuities are to be given to employees on reaching 65 years of age and will be based on 2% of total earnings, with a minimum of $300 per annum. Ample financial provision is to be made in the case of accidental injury. The experiment of closer personal cooperation between employer and employee has been commenced at a time when relations are particularly cordial; and it is fully expected that reunions of this kind, where anything of the nature of a grievance can be freely discussed, will tend to preserve and augment the good feeling already existing.

HOUGHTON, MICHIGAN

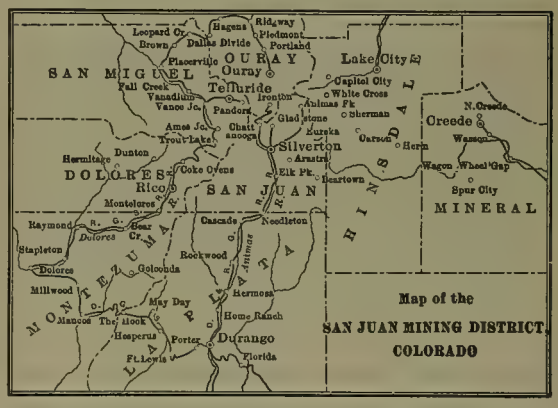
Decision of Supreme Court on Rights of Shareholders.

The decision of the Supreme Court of Michigan, reversing the action of the lower Court in the case of William A. Paine v. the Trimountain Mining Co., is one of vital importance not only to mining but to all corporate interests in the State. The action was a great surprise to corporation lawyers. Practically, it means that minority shareholders of operating concerns can block the dissolution of any corporation when that dissolution is wanted simply as a matter of convenience in doing business. Mr. Paine is president of the Copper Range company, which has absorbed the Champion, Baltic, and several other subsidiary companies. The basis of exchange for Trimountain shares was generally considered not only fair but more than reasonable, yet some of the shareholders would not agree. The consolidation, therefore, could not be effected without action in court, compelling the minority shareholders to surrender. This they did, with two exceptions. One of these was Senator Saulsbury of Delaware, who had been 'hooked' with a large block of Trimountain share in the days of high finance. The other shareholder was Michel M. Foley, assistant county treasurer of Houghton county, Michigan. Charles Briggs, president of the Calumet & Arizona company, which had done considerable absorption of its own at one time and another, also held out as a minority shareholder in Trimountain until the case went to court. Saulsbury and Foley protested against the action in court. They were defeated, but appealed to the Supreme Court. This tribunal—the highest in Michigan—decided unanimously in their favor. The decision was written by Justice Bird and concurred by all the other justices on the bench. Quoting the decision: "It appears to be the desire that Copper Range shall become the owner of all the shares instead of a portion of them. The idea back of this desire is said to be that the cost of operation can be materially reduced if the property can be operated as a unit with the Baltic and Champion. This may be commendable as a business proposition, but it is no measure of respondent's rights. The respondents made their investments when the mine was more or less of a speculation. They have been loyal and retained their investments during the years of physical development and financial vicissitudes, and now when the project has been proved to be a success they must be driven out by a forced sale of their investments for no better reason than that the larger stockholder desires to acquire it in the interest of economy."

DURANGO, COLORADO

Weather, Transport, Development, Production, and Plants in South-Western Colorado.

General.—Exceptional weather during the past winter was very favorable for mining in south-western Colorado. For a number of years there has been heavy snow and severe storms that seriously impeded shipments and development. All large producers in the principal districts continued normal shipments until January, when the Red Mountain district practically closed down for the season. The first storm that seriously interfered with railroad traffic occurred dur-



ing the past week (prior to March 18), which prevailed over the entire south-western region. The Silverton district was covered with two feet of new snow. Numerous snow-slides occurred at points on the Denver & Rio Grande between Durango and Silverton; also on the Rio Grande Southern, stopping all shipments and traffic for a week. If favorable weather continues, movement of ore from mines to smelters will be about normal in a week. At points on the Silverton branch, snow-slides cover the tracks to a depth of 50 ft.; and on Cumbres pass, where the narrow-gauge crosses the Continental Divide in order to connect with the main line, the snow is 17 ft. deep.

Durango.—The Durango smelter has been extensively remodeled during the winter, and is prepared to receive the large tonnages expected during the forthcoming season. A large Dwight-Lloyd sintering-machine was erected in quick time, and is in operation. It has increased the smelter's capacity considerably. A new Cottrell precipitating plant is nearing completion. An experimental flotation plant has been giving good results. Temperature of the flotation water has been increased and speed of the impellers has been raised. The plant is producing zinc concentrate.

A new power-line has been constructed to the San Juan coal mines. This will make the property as safe as possible, although it already has a creditable record. The San Juan coke-ovens are to be increased.

May Day.—Mining in La Plata district is temporarily at a standstill, although extensive prospecting development of small claims is evident. Ore from the district, while carrying silver and gold, is highly silicious.

Among recent shippers from May Day is the Jumbo mine, George Gilmore, manager. This mine will probably be a large producer during the coming season.

The Comstock Lode has been re-opened. It has been reported as being very rich.

The Small Hope Mining Co. has had several men engaged during the past few months, and will endeavor to ship fair quantities of ore.

The old Tippecanoe claim is being developed.

Among the mines upon which most extensive development has been done is the Puzzle, promoted by Ralph Hutchinson and others.

The Idaho Leasing Co. has not been shipping for some time, but is reported as making considerable improvement.

Rico.—This district is promising for ore shipments during the coming season. Despite the snow and shortage of labor, the Rico Argentine Mining Co. has been shipping heavily. The superintendent, William McCullough, anticipates a prosperous year, the output to exceed former years. The large indebtedness that has encumbered the company has been greatly reduced, and this will soon be wiped out.

The Rico-Marmatite Mining Co. has been a steady shipper of zinc ore.

The Rico Mining Co. has shipped some zinc ore during the past two months.

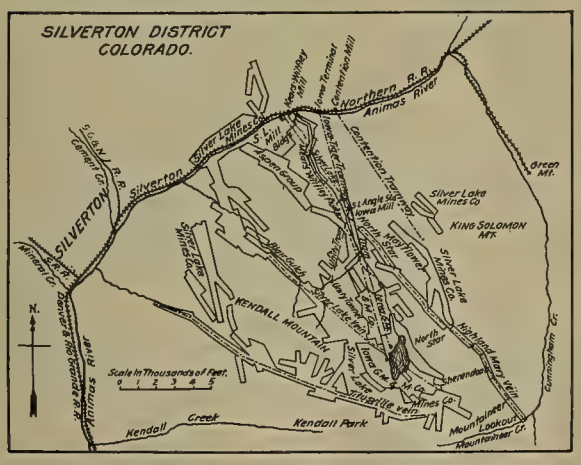
Extensive development is to be done on the Calico Peak potash beds, resulting from an extensive examination of the property by Mr. Avery, general manager for the Colorado Alunite Company.

The Rico-Wellington Mining Co. has erected a small compressor, to be able to operate machine-drills when hard rock is encountered.

The Cadiz Mining Co. has taken over the Lillia D. property. If lack of transportation facilities does not interfere this concern will develop the property considerably. Ore carries lead and zinc.

The Mount Pleasant company has employed a few men and has opened rich ore.

Silverton.—Until the recent blockade, this district has been maintaining steady shipments of ore, and had a prosperous winter. The North Star mill has been busy dressing ore from neighboring mines, and operated without any serious breakdown throughout the winter. The Silver Lake mines output alone has been a heavy one to handle, and the mill has done well. The Silver Lake custom mill ceased operations at the close of 1917. It worked for two years and has been closed indefinitely, owing to high cost of operation and maintenance.



The Silver Lake mines, operated by the S. D. & G. Leasing Co., have continued heavy shipments of high-grade ore to the Durango smelter during the winter, except for a short period during January, when a severe wind-storm broke down some aerial-tram towers.

The Iowa-Tiger property made regular shipments to the Salida smelter, except for a short time when strong winds blew down a few tram-towers.

The Hamlet Mining Co. has spent a large sum in remodeling its mill and developing the mine. It is producing good ore, and the manager expects the output to exceed 200 tons per month during the coming season.

The Anvil Leasing Co., Edw. Johnson, manager, has sub-leased the Emerald Lode property from Andren & Jackson, former lessees, and is making regular shipments to the Durango smelter. This mine has always been considered of promise.

An interesting development near here is that of the Silverton, Mining, Milling, Tailing & Recovery Co., which is building a large flotation plant just outside of the city limits. The company has been organized with the object of treating the rich tailing that lies along the river-front, resulting from extensive placer work done here years ago. Company has leased the river lands on both sides for a distance of five miles. It is expected that the sand will be frozen for the greater part of the year, and in order that the flotation plant may be continuously employed during winter the company has purchased several good mining properties near by.

Robin.—The Mayflower Leasing Co. has been a steady producer, but at present there is little doing, due to poor shipping facilities, and other factors. The Mayflower produces a lead ore, high in silver.

Eureka.—The Sunnyside Mining & Milling Co. has a large number of men completing its new mill and flotation plant. Shipments are temporarily suspended. With the new plant in operation, eliminating zinc, it is to be expected that the Sunnyside will continue to ship rich lead-silver ore.

Red Mountain.—The Red Mountain Mines Co. had men on development since stoppage of shipping in January. During the short period this company operated last year copper-sulphide ore was produced in good quantity. The snow on Red Mountain is reported as being nine feet deep. Mail and supplies are being carried by pack-train.

The Summit properties have been a scene of great winter activity, and will probably figure strongly in shipping during the coming season. These produce large quantities of low-grade copper ore.

The Congree mines have men during the entire winter, and the lessees, Offerman, Klang & Johnson, and the Kapegi Leasing Co., will be ready to ship as soon as snow melts.

Green Mountain.—This district is preparing for a good year. In view of the prevailing high prices for metals it is likely that many old claims, carrying rich ore, will be re-opened.

The Pride of the West Leasing Co. has been making heavy shipments, although hampered for a time by the collapse of two tram-towers.

The Dives Leasing Co. is making regular shipments of rich lead-silver ore.

The Highland Mary Leasing Co. has been operating steadily, shipping ore and concentrate to the Durango smelter.

Gladstone.—The Gold King Leasing Co. is preparing to ship.

A New York company, known as the Minnehaha Mining & Milling Co., has been formed to operate the Minnehaha claim. This claim has never been worked to any extent.

Telluride.—The Smuggler Union Mining Co. has been

shipping about 2000 tons per month. Flotation concentrate has increased greatly, in fact, most of the shipments are of this material. The output of iron concentrate has not diminished.

The Tomboy has been shipping 1500 tons per month, principally iron concentrate.

Lack of cars, snow, and mud-slides along the Rio Grande Southern have hampered shipping from these properties.

The Liberty Bell has been shipping 300 tons per month, and will gradually increase the quantity as the season advances.

Ophir.—The Carbonero Leasing Co. has been developing and shipped a few cars of ore. It is probable that this mine will be one of the important producers during the current year, as it is backed by a strong company.

The Carribeau Trust Co. is operating a mine in the Ophir district. The manager reports good results by flotation. Several cars of ore have been shipped, high in copper. There are large bodies of good ore undeveloped.

Ouray.—Shipping from this district is at a standstill. The Wedge and Pony Express properties show some activity, and have shipped a few cars since the first of the year. High freight-rates, coupled with a run of lower-grade ore, have temporarily brought operations to a close. Carney and Kelliher worked on the Wedge dumps and shipped some good silver ore. The Black Girl has not shipped so far. The Senorita mine closed down early in January. Among recent shippers are the Silver Point, operated by The Miners' & Merchants' Bank of Ouray, and the McCluskey's Cliff mine.

The mines of this district have always been good producers, and should ship considerable ore during the coming season. The price of silver will govern production, as all ores carry silver, and are suitable for smelting.

PLATTEVILLE, WISCONSIN

Principal New Work Under Way in Main Districts.

Spring weather has revived mining in the zinc-lead region, and many schemes set back by winter are to be resumed.

Benton.—The Frontier Mining Co. of Indianapolis, Indiana, is launching extensive development on land north and east of here proved by drills. On the Grotkin land, where the Bull Moose and Middie mines are now producing extensively, another large ore deposit is being opened. This will be connected by underground tramways with the main mill at the Bull Moose mine. This company will also develop and equip the Little Minnie mine, closed since 1907.

Local mining men, backed by Milwaukee captial, are completing a 300-ton concentrating plant at the Blende mine. Twenty years ago, by primitive methods, this property paid the owner, on 10% royalty, over $60,000. Records show that blende of high grade sold at $8 to $21 per ton.

The Thomas Calvert farm, on the famous Swindler Ridge, is being exploited by the Vinegar Hill Zinc Co. The tract has been drilled. A two-compartment shaft will be sunk without delay, and a 300-ton mill erected on a short-term contract.

The New Jersey Zinc Co. is busy on a property formerly known as the Little Bennie. Recent work shows that drifts were driven by former owners just over the top of the main orebody, which is several feet thick and of fair grade. The mine is being dewatered, and the new ore opened. This mine is connected with the Fox mine, a consistent producer. The New Jersey company's Hoskins mine is producing as much as 10 cars of ore per week.

The Vinegar Hill Zinc Co. is coming into undisputed possession of the Sally mine, and operations will be resumed in the near future.

The Grand View Mining Co., controlled by Indianapolis people, will also be re-opened. Some high-grade zinc carbonate ore is exposed in the upper levels, and is sold to the Mineral Point Zinc Company.

The Robinson, Greater, Buchan, Domestic, Strawbridge, and Longhenry mining companies are all being revived. All have ore and require additional capital to make them profitable enterprises. Each is in the heart of the Benton zinc belt, and all have considerable merit.

Ore-loading facilities are being improved in this district by use of gondolas to which shippers, especially of high-grade zinc ore, have long objected. Shippers of wet concentrate, however, are taking advantage of the coal cars by putting in wooden bottoms. The car scarcity, acute all winter, is being eliminated in this way.

Cuba City.—A new 300-ton mill has been completed at the Connecting Link mine. The mine is an extension of the Dall range, and is opening large deposits of high-grade zinc ore.

The Hercules Mining Co. will build a new mill as soon as the weather permits.

The Big Eight Mining Co. is drilling the hills for extensions of the Raisbeck range, so far with indifferent results.

Hazel Green.—Knolte brothers have a promising new zinc producer on the Crawford estate.

New Diggings.—The Galenite Mining Co., recently incorporated with capital of $20,000, has a 40-acre tract here. Two shafts only 26 ft. deep are in ore. A drill will be used to prove this.

Livingston.—The Livingston Mining Co. has been organized to develop property near the New Jersey Zinc Co.'s Coker mine.

Platteville.—The Block-House Mining Co., which sold over $500,000 of zinc ore in 1917, is holding $75,000 of separator blende for better markets. Extensive development is planned by the company on its new Reilly deposit.

CRIPPLE CREEK, COLORADO

Gold Output and Dividends.—Portland Mill Closed.—Lease Notes.

Gold output of the district in March totaled 92,470 tons, averaging $9.47 per ton, making a gross value of $875,880. Quantities treated and values were as follows: Golden Cycle (Colorado Springs), 26,700 tons, $20 per ton; Portland (Colorado Springs), 8370 tons, $17.50 per ton; Portland (Independence mill, Cripple Creek), 41,000 tons, $2.02; Portland (Victor mill, Cripple Creek), 13,100 tons, and Smelters (Denver and Pueblo), 2500 tons, $55 per ton.

Dividends paid in March were as follows: Cresson, $122,000, and Golden Cycle, $45,000. These companies will pay similar amounts on April 10. Dividends for the first quarter of 1918 have totaled $591,000, as follows: Cresson, $366,000; Golden Cycle, $135,000; and Portland, $90,000.

The Colorado Springs mill of the Portland company closed on March 3. This plant commenced work in June 1902, and has extracted gold worth over $35,000,000 from Portland and custom ores.

The Forest Queen Mines Co., recently incorporated to operate the Edwin Gaylord lease at the Forest Queen mine, produced 400 tons of 1-oz. ore during March. This is the largest monthly output since the lease was issued 16 months ago.

The Cobb sub-lease on 500-ft. level of the Dante mine, Bull hill, returned $10,000 gross last week from 4 cars of ore, according to statement made by the company's secretary. One carload assayed $137 per ton. The mine is leased to the Big Toad Gold Mining & Milling Co. This company has engaged Thomas Kavanaugh, metallurgist, to operate the plant, formerly known as the Reid mill. Treatment of low-grade mine ore has commenced.

THE MINING SUMMARY

ARIZONA

Jerome.—United Verde Copper Co. has declared a dividend of $7 per share, the second of like amount this year.

Green Monster company is doing development only at two points, a half-mile apart, at its Revenue and Cliff mines. At the former, a strong jasper vein is being followed by means of workings 415 ft. below the winze from the Rattlesnake adit. At the Cliff, the Gorge adit has cut two bodies of mineralized schist carrying copper pyrite. Thirty-five men are employed, working two shifts in four places. Property is fully equipped with electric hoist at shaft, pumps, compressors, etc.

Miami.—Gila county's resources are described in an interesting manner by Edward Oliver in a 31-page booklet. There is nothing new in the matter, but it is arranged attractively.

Patagonia.—Frederick Colberg, who recently acquired the Flux mine near here, is to erect a mill.

Prescott.—Storm Cloud claims in Hassayampa district are to be re-opened by the O'Brien Syndicate. No work has been done for 10 years.

Bannie Mining Co. in Walker district is installing an 80-hp. boiler, 5-drill Ingersoll-Rand compressor, etc., and will deepen shaft from 190 to 500 ft. depth. Property is considered promising.

CALIFORNIA

Drilling operations in the oilfields, as shown by reports made to the State Oil and Gas Supervisor, R. P. McLaughlin,



show a decided decline in comparison with those of a year ago. During the past week 11 new wells were started, making a total of 166 since the first of the year, an average of 14 per week. During the same period last year 270 wells were started, an average of 23 per week. Operations in the Montebello field continue active. The use of rotary tools has been the cause of friction between various operators, based on the belief that oil-sands may be passed through without identification and proper protection. The State Mining Bureau recently held a formal hearing for the purpose of determining the facts underlying certain complaints. It developed that there is considerable uncertainty as to the existence of productive sands when rotary tools are used throughout the drilling operations. It may become necessary for the Bureau to place certain restrictions on the use of such methods. Some companies operating in the field, namely, the Amalgamated and General Petroleum, propose to use rotary tools to the limited depth of about 1200 ft. and finish the wells with cable tools. Experience in other fields has already shown this method to be far preferable where there is uncertainty as to the depth of productive sands, and similar prudence on the part of all operators may obviate the necessity for drastic regulation.

Engels.—U. S. Bureau of Mines rescue-car No. 1, with J. J. Forbes, Dr. J. F. Worley, J. V. Berry, T. M. Genty, W. W. Weir, H. M. Wolfiin, and J. H. Kisse, was at the Engels copper mine part of last week.

In 'Economic Geology' for March, L. C. Graton and D. H. McLaughlin give further notes on ore of the Engels copper mine. This and the previous investigation concerned secondary enrichment of the ore. Mr. Graton considers that the chalcocite is of secondary origin.

Gazelle.—W. L. Brown has made an initial shipment of two carloads of high-grade chrome ore mined on his ranch.

Grass Valley.—Golden Center company has opened two feet of $20 ore on 500-ft. level, 600 ft. from main shaft.

Hornbrook.—James Ladd of Gottsville has shipped from Hornbrook an initial shipment of 42% chrome ore from his Snowflake mine.

Keswick.—Mountain Copper Co., which is doubling capacity of its flotation plant at Minnesota station, is greatly hampered in construction by the inability to get material.

Kennett.—Only 120 men are employed at the Mammoth mine, where a year ago the number was 700. The Mammoth company is working outside properties—the Shasta King and Stowell mines—and is receiving large quantities of ore from the Balaklala and the Bully Hill, so it is not necessary to work the Mammoth mine to capacity to keep the smelter running.

Oroville.—California National company is to erect a 1500-ton mill near here to treat the low-grade gold ore being developed. The deposit is wide and averages $2.50 per ton. Ball-mills are to be used.

Butterfly mine in Morris ravine is to be re-opened. It was formerly worked as a lode mine, but a gravel deposit was found by the last owners. It is proposed to extend the adit and develop the channel. W. T. Baldwin, R. S. Kitrick, and C. F. Belding are interested.

Local people are forming a company to prospect ground in the Cherokee district where two diamonds of good quality were found recently. Prospectors assert a true kimberlite formation has been found.

Portola.—Walker Mining Co.'s property is improving all the time. The mill is dressing 100 tons of 4 to 6% copper ore daily, yielding concentrate carrying 20 to 22% copper and $8 to $9 gold and silver per ton. Recovery is from 95 to 97%. Ore-reserves are said to be sufficient for a much larger plant. New shaft is down 476 ft., where a station is being cut. Hoist is motor driven. Orebody has been proved on strike for over 1000 ft., of good width.

Washington.—Columbia Con. has 20 stamps dropping, and 25 men employed. Sufficient ore is exposed to keep the plant running for several months. Prospecting new ground is proceeding. E. C. Klinker is superintendent.

COLORADO

Boulder.—Tungsten Products Co. has been organized with capital of $2,500,000, to develop the Lucky Two and other mines at Boulder Falls. About $200,000 will be spent.

Mojave Tungsten Co. will probably resume operations at its mine and mill in near future.

Grim mine at Boulder has been taken over by Kansas City people. Sampling works and other plant are to be erected. New company is styled the Boulder Canon Tungsten Company.

Creede.—Champion Mining Co. has decided to re-open its Campbell Mountain silver mine as soon as financial arrangements are complete.

Cripple Creek.—Portland company closed its Colorado Springs mill on April 1. Such a course was intimated in the report for 1917. High-grade ore will now be treated at the Independence mill at Cripple Creek. Some machinery will be transferred, meanwhile this ore goes to the Golden Cycle plant at Colorado City. At Portland mine all sections down to 1700-ft. level have been mapped out for leasing.

De Beque.—American Oil Shale Co., operating in a canyon 7½ miles from here, is erecting a 150-ton distilling plant. Shale in this region contains 66 gal. of oil per ton.

Golden.—In the Colorado School of Mines 'Quarterly', April 1918, Victor C. Alderson contributes 30 pages entitled 'The Nature, Origin, and Distribution of Oil-Shale'. The Scotch shale industry is described, and briefly other foreign deposits. The remainder of the article considers the situation in Colorado. All interested should secure a copy of this article.

Montrose.—Sampling-works to handle radium-bearing and other ores of the San Juan region are to be erected here.

Ophir.—Carribeau Trust Co. is about to start shipments to the Durango smelter. The manager, George L. Bingham, has improved the flotation process considerably. A high-grade copper concentrate is made.

Ouray.—Mining men have their attention centred on the Cow Creek section of this district, where molybdenite was discovered by a prospector at the beginning of winter. This area has long been regarded as worth exploration, but its inaccessibility has been a handicap. It is considered to be one of the wildest portions of the remote mountains of the Rockies. At various times there have been discoveries by hardy prospectors, who uncovered placer deposits that were soon exhausted, but no large orebody has been found. In addition to minerals, prospectors report indications of large coal and oil-shale deposits in this district.

The Indiana mines will be operated by A. B. Eisman, who has taken a lease of the property during 1918. Electric power will be used to operate drills.

The new Crawford mill at Ironton is nearly completed, and will be in operation at the beginning of the season.

The Mountain Top company has been shipping a rich silver ore, one carload being reported as bringing a net return of $5000. A vein carrying 300 oz. silver has been opened in places. Recent profits from the mine have resulted in many improvements, among which are a long tram to facilitate handling of ore from the Mountain Top to the basin below. A large ball-mill has been erected.

Silverton.—Plans have been made for extending the 2000-ft. Mammoth adit through Red mountain. With laterals, this tunnel will serve many properties.

Telluride.—The road to the Tomboy was blocked by snow for a week but is now open to sleigh travel.

Auto-trucks are again hauling ore from Placerville, after a lay-off for a month, on account of muddy conditions of roads. Roads of the district are reported to be in good condition now, as there has been a long period of drying weather.

Oil-shale lands of the district are being developed by Mt. Blaine Oil Shale Products Co., which has installed a 100-ton reduction plant near the town of Norwood.

The Belmont-Wagner mines are operating.

The Caruthers lease is shipping large quantities of ore to Perino mill. A large Huntington mill has been installed and as soon as electric power is available the season's run will be started.

There are large deposits of manganese ore in La Sal mountains, and in view of the prevailing demand for the mineral, it is possible that capital may develop this rich district.

IDAHO

Fatalities in mines of this State during 1917 totaled 21. There were 204 injured, losing more than 14 days time each, and 650 losing under 14 days.

Kellogg.—At least 1000 additional men are needed by mines and works in the Coeur d'Alene region, according to H. R. McBride, employment agent of the Coeur d'Alene Mine Owners Association at Kellogg. The companies have been advertising without success, and the situation is now acute. The chief companies affected are the big producers, and a reduction in output is threatened unless relief comes soon. Wages vary from $3.75 to $5.25 per day.

MICHIGAN

Houghton.—Mayflower-Old Colony company levied an assessment of 50c. per share on April 8.

Iron Mountain.—Amasa Porter iron mine is being unwatered to recover the bodies of 14 miners entombed there February 21. It will require at least six weeks to remove sand and water before operations can be resumed.

Pewabic iron mine will stop operations in the near future. Recent openings have been in poor ore, grade gradually getting worse and no hope for improvement in future. Twenty years ago Pewabic was one of the big operating iron mines of Iron Mountain district.

MISSOURI

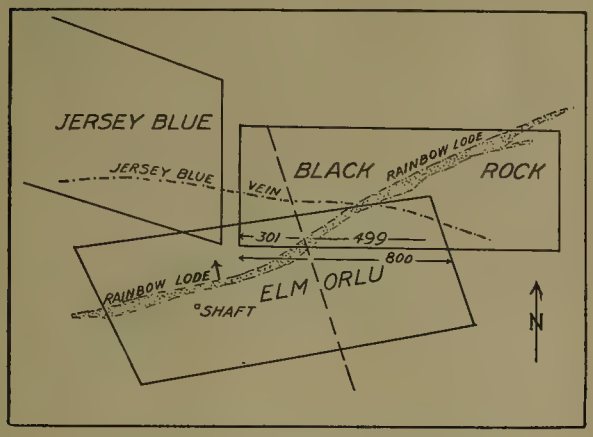
Joplin.—Production of Missouri-Kansas-Oklahoma region last week was 8778 tons blende and 1465 tons lead, averaging $47 and $85 per ton. Total valuation was $541,797, making $6,292,105 for 13 weeks. Oklahoma contributed $233,940 of last week's output. Zinc-ore prices fell off $2.50 per ton.

MONTANA

Butte.—Anaconda pays $2 per share on May 27. This makes $4 for the current year.

Regarding the Elm Orlu v. Butte & Superior apex dispute, D. C. Jackling stated to the 'Boston News Bureau' as follows: The Elm Orlu decision, recently affirmed by the U. S. Circuit Court of Appeals at San Francisco, involves a length of about 300 ft. of the so-called Rainbow lode development in the west end of the Black Rock claim of the

Butte & Superior group. In that portion of this claim, two principal veins have been developed; one the Rainbow, as previously referred to, and the other known as the Jersey Blue. The Court's decree is based upon an assumed crossing of these veins instead of a junction, and the Jersey Blue vein is not involved in the decision above the 1200-ft. level. To what extent it will be involved below that level can only be determined by future development. Taking the situation on its face today, however, it may be said that the total length of orebodies developed along the Rainbow and Jersey Blue lodes in the Black Rock claim and the property belonging to the Butte & Superior lying east of the Black Rock, is about 1800 ft. Therefore the length of lode system decreed in part to the Elm Orlu claimants is about



CLAIM MAP OF ELM ORLU AND BUTTE & SUPERIOR

one-sixth of the total length developed in the Butte & Superior properties from all parts of which system above present working-levels profitable ore has been or is now being mined. The size of orebodies and their grades vary on different levels throughout the length of the entire system, and it is impossible to say definitely what relative value the 300 ft. involved in the decision would bear to the remaining 1500 ft. of developed orebodies not so involved. If for purposes of illustration, it is assumed that the developed system of veins is of equal value throughout their present developed length, then the decision involves one-sixth of the orebodies developed through the Butte & Superior workings. It should be stated, however, that to present depths the orebodies decreed to the Elm Orlu are somewhat larger than the average of the orebodies throughout their full length developed in the property, and it is believed a fair statement of the situation would be that the orebodies lost to the Butte & Superior Co. by this decision approximate but do not exceed one-fifth of the profitable developments to depths at which we are now working. This, of course, constitutes a very important and valuable block of ore, but it is in no wise vital to the Butte & Superior or its operations now, or for an indeterminate, but very long time in the near future. As to the monetary value involved in the decision, the lower Court found that the ores taken by the Butte & Superior in violation of plaintiff's rights justified an award of damages plus interest in the total sum of $177,707.40. There was another branch of the case which was not wholly determined by the Court. This involved claims on the part of the Elm Orlu that it was entitled to a further extension eastward of the orebodies developed in the Black Rock by virtue of apex-rights through what is known as the Pyle Strand, which plaintiffs claim is an easterly extending branch of the Rainbow lode. To what extent this may affect further portions of Rainbow lode bodies lying within the Black Rock can only be determined, of course, by future developments and decision; but in any event the outcome will leave unaffected very large and valuable portions of the developed orebodies lying entirely east of the east end of the Elm Orlu, and therefore under no possible circumstances involved in any apex-rights the Elm Orlu may assert, to say nothing of the important orebodies which will undoubtedly be disclosed by the westerly development of the Jersey Blue lode in the Jersey Blue claims.

The U. S. Circuit Court of Appeals at San Francisco has denied the Butte & Superior company's petition for a rehearing of the appeal from Judge B. Bourquin's decision in favor of the Elm Orlu in a suit involving orebodies in the Rainbow fissure beneath the surface of the Black Rock claim of the Butte & Superior company.

Great Falls.—Gas in sufficient quantity has been developed by Anaconda company in the Sweet Grass hills, 70 miles north of this place, to warrant piping it to the company's properties in Montana. No. 1 well is yielding over 11,000,000 cu. ft. of gas at present, and No. 2 about 4,000,000 cu. ft. Anaconda is exploiting the Montana-Canadian Oil Co.'s property of 100,000 acres. Two companies are to be organized by Anaconda, one to develop the area, the other to construct the pipe-line. Montana-Canadian company would receive 10% of each. To lay pipe to Great Falls, Helena, Butte, and Anaconda, a total of 156 miles, would cost over $8,000,000.

Rimini.—At Lee Mountain mine a large body of silver-lead ore was recently opened at distance of 1000 ft. from portal of adit. Vein is 7 ft. wide. About 25 men are employed. This mine has been worked intermittently for 25 years. Morton Webber is consulting engineer.

NEVADA

Goldfield.—Red Hill Florence has secured from Goldfield Consolidated whatever apex-rights may exist on the veins lying within its boundaries, but which may extend on their upward incline into the Combination claims of the Consolidated. Heretofore Red Hill Florence possessed extralateral rights to ore continued in veins apexing in O. K. and Rustler fractions only, and while the Red Hill had a lease on certain of the Combination claims, it did not control the rights to ores apexing in the Combination. The agreement made last week is understood to have placed within the control of the Red Hill extralateral rights not only to veins apexing in O. K. and Rustler fractions, but in the Combination as well. Owing to the fact that the vein in which high-grade ore has been opened below 400-ft. level dips to the east, near the boundary of the adjoining Florence, question had been raised in mining circles as to Red Hill company's title to ore extending beyond its boundaries. Work on the vein above 400-ft. level has now demonstrated that the apex must be to the west of Florence-Red Hill joint boundary, and the new agreement with the Consolidated covering all the territory to the west, in which the vein must have its apex, settles beyond question the right of Red Hill company to proceed with mining of ore at any depth to which ore may be found to extend. Shipping ore has been opened for some distance on 500-ft. level. Over 200 tons is ready on surface to be sent to smelters.

Atlanta Mines Co. expected to reach main vein on 1900-ft. level by end of March, in any event, during April.

Great Bend is breaking shipping ore from several faces, the best coming from above 160-ft. level.

Mill City.—Tungsten shipments from this district amount to 150 tons daily. This quantity will be increased when present work opens the mines properly. About 100 men are employed. From Mill City the ore is railed to Toulon, near

Lovelock, for concentration. Scheelite occurs in veins that are persistent with depth. At the Uncle Sam an adit has been driven on a vein for 300 ft., the face being 176 ft. deep. Vein is 6 ft. wide, and 4500 tons averaged 2.11% WO_3. Lessees are shipping 3½% ore. L. A. Friedman has a shaft down 85 ft. on a 6-ft. vein. Ore carries 2% tungstic acid. It is proposed to erect a custom mill here.

Virginia City.—Concerning operations on the Comstock, Whitman Symmes states that results of many months work are becoming apparent, notably in the case of Union Consolidated, which is maintaining its production without aid from high-grade ore. Ore is being opened as fast as it is taken out. There are two-cross-cuts, one on 2400 and the other on 2600-ft. level, which will tend to prove further the size of the orebody, which centres in workings at 2460 ft. As opportunity permits, encouraging indications on the 1600, 2000, 2700, and 2900-ft. levels are to be followed. Cross-cuts on 2400 and 2600-ft. levels are not yet far enough advanced to reach the ore, but at 2500 ft. a drift for 73 ft. was in good ore. At 2300 ft. there is good ore in the south drift, considerably to the east of the 2400-ft. level ore-shoot. The ore went only to the top of the drift, but was solid on the floor, with 7 to 8 ft. of quartz. This should be cross-cut at 2400 ft. From 2460 to the 2400-ft. level, stoping has been done only at the north end. There is a fair amount of ore remaining between the 2400 and 2300-ft. levels. From 2500 to 2460 ft. is untouched, and this will supply milling ore for a considerable period.

Mexican mill here is to be enlarged to take care of the steadily increasing output of the Comstock Lode mines, particularly the Union Con., Con. Virginia, and other North End properties. The plant is taxed to capacity to treat ore coming from the Union Con., Ophir, Mexican, and Con. Virginia.

Reported by United Comstock Pumping Association that operations last week consisted of the following: At C. & C. shaft the Reidler pumps on 200-ft. level ran as follows: No. 1, 72 hours; No. 2, 143½ hours; No. 3, 120¼ hours. The centrifugal pumps at 2310-ft. station ran: No. 2, 168 hours; No. 3, 168 hours. No. 2 shaft-pump at 250-ft. station ran 168 hours. The pumps on 2700-ft. level ran: No. 3, 109¼ hours; No. 4, 58¾ hours. Pumps on 2900-ft. level ran: No. 1, 120 hours; No. 2, 48 hours. On 1600-ft. level main south drift from the Union shaft leading to the north lateral of Sutro tunnel is being repaired. This drift is used to turn the drainage-water, and is one of the main outlets for the northern mines. At Ophir shaft general repairs to shaft were made.

OKLAHOMA

Douthat.—Forty-acre lease of C. H. Plumb and Edward Wilkins of Joplin has been sold for $50,000 to E. R. McClelland of Kansas City. The St. Regis mill at Duenweg, Mo., is to be moved to Douthat.

Lincolnville.—This old district is again assuming importance. Considerable drilling is being done, and 10 mills are completed or under construction.

Miami.—Miami National Lead & Zinc Co. will soon have two mills in operation, one of 200 tons capacity at Badger, the other of 150 tons at Peacock. Rich ore has been opened. H. C. Austin is general manager.

Picher.—Production of this region last week was 3782 tons blende and 750 tons lead, valued at $233,940.

OREGON

Homestead.—The Iron Dyke copper mine here, in northern Oregon, near the Idaho line, is said to have ore worth $1,000,000 opened above 300-ft. level. Monthly profits to people connected with the Goodrich Rubber Co. are reported as $75,000 to $95,000. A wide orebody, carrying 3 to 5% copper and $8 to $10 gold per ton, has been developed.

TEXAS

Rule.—Texas Development & Mining Co., with headquarters at Nacogdoches, will build a smelter at its copper mines near here.

Terlingua.—Mariposa Mining Co. has leased the 50-ton Scott quicksilver furnace belonging to the Terlingua Mining Co. in this district of Brewster county, and will put it in operation as soon as it can be overhauled, which will require from 30 to 60 days. The Mariposa quicksilver mine adjoins the Terlingua mine. It is equipped with two 10-ton Scott furnaces, having a capacity of 100 flasks of quicksilver per month. The Terlingua furnace will be supplied with low-grade ore from the Mariposa, of which there is 32,000 tons on dumps, containing, according to report of the engineer, more than $241,000 of mercury. Some high-grade ore will be added to the dump material, and according to report of William B. Phillips, consulting engineer, the expected output of quicksilver will be from 250 to 300 flasks per month. F. M. Dancy is president.

UTAH

American Fork.—Pacific Mining Co. paid 1c. per share on April 5. This is No. 3, equal to $4000.

Bog Mining Co. has resumed work, and is extending its adit 100 feet.

Bingham.—Alleging that the United States Mining Company had extended adits and workings into his property, known as the Nemesis lode, and had extracted ores therefrom fraudulently, Colonel E. A. Wall filed suit for $16,875,000 damages against the company in the Federal Court at Salt Lake City on April 4.

Garfield.—Utah Copper Co. may have labor troubles, as last week a meeting of those involved voted 84 for and 9 against a strike, in order to obtain guarantees against discrimination of union men employed by the company. Union men are said not to be receiving fair treatment when numbers of employees were being discharged. The general manager, R. R. Gemmell, says that the company continues to operate on the open-shop system, not asking any man whether or not he carries a union card; it is entirely a matter of efficiency. There are at present employed approximately 3500 men at the two concentrating plants at Magna and Arthur. Mr. Gemmell said that the reported vote of 84 men favoring a strike would represent a small and unimportant part of the total number employed at the two plants. However, it is the general expectation that the matter may be settled in an amicable manner.

Park City.—Mines of this district in March shipped 11,109 tons of ore and concentrate, against 9222 tons in February. Producers were as follows: Ontario, 3190; Judge, 2615; Silver King Coalition, 2717; Silver King Con., 1153; Daly West, 1094; Iowa, 132; Naildriver, 155; and New Quincy, 53 tons. Value for three months of 1918 is $1,500,000.

Tintic.—Mines of this district in March shipped 41,000 tons of ore and concentrate. There are 24 producers in the list, headed by the Dragon, Chief Con., Iron Blossom, Mammoth, Grand Central, Eagle & Blue Bell, and Centennial Eureka.

WASHINGTON

Republic.—Lone Pine-Surprise company, operating Last Chance mine, has sunk its shaft 530 ft. At 500 ft. shaft cut the vein, where it is 8 ft. wide. A station 11 ft. wide, 15 ft. high, and 15 ft. long was cut out, partly in ore. A loading-pocket of similar dimensions was cut below the level. Drifts each way—198 and 86 ft.—were in ore all the way. Average width is 8 ft. Shoot has yielded over 6000 tons of ore, assaying $12.50 per ton. Just south of the shoot the

vein is split into stringers a few inches to 30 in. wide, averaging $7.50 per ton. Metal content is 66% gold and 33% silver. Ore is shipped to smelters. The mine is in fine physical condition. C. P. Robbins is manager.

CANADA

British Columbia

Dividends paid by companies operating in this Province are as follows for the first quarter of 1918, compared with the previous period:

	Last quarter 1917	First quarter 1918
Granby Con.	$374,962	$374,962
Consolidated Mining & Smelting	260,445	261,935
Hedley Gold	60,000	36,000
Standard Silver-Lead	100,000	.....
Total	$795,407	$672,897

Princeton.—Canada Copper Corporation has completed its 2900-ft. tunnel through Copper mountain. The opening is 9 by 11 ft., and will facilitate removal of over 10,000,000 tons of ore in the upper horizons. A vertical raise 720 ft. high will be driven from the tunnel. Surveys for mill-site are under way. Oscar Lachmund is general manager.

The Kettle Valley railroad has let contract for the construction of 14 miles of line from Princeton to Copper Mountain, to serve the Canada Copper company's property. Amount involved is said to be over $1,000,000.

MEXICO

A Consular Report of March 27 states that the American Ambassador at Mexico City has telegraphed the following decree of March 22, concerning the exportation of gold and silver, which modifies the decree on the same subject of September 27, 1917, referred to in 'Commerce Reports' of October 1, 1917:

Article 1. The exportation of silver bars and of bars of gold and silver mixed may be made only with the special permission of the Secretary of the Treasury and Public Credit in each case.

Art. 2. For the exportation of ores and concentrates containing gold and silver the provisions of the decree of September 27, 1917, shall continue in effect.

Art. 3. The absolute prohibition of the exportation of gold bars of domestic production and of domestic and foreign gold coins and domestic silver coin continues in effect.

Art. 4. Subject to arrangements to be made in each case with the Treasury Department, the exportation of silver coin (pesos fuertes) may be permitted on condition that gold bullion equivalent in commercial value to the coin is imported at the same time for coinage at the mint.

Art. 5. The monetary commission, with the approval of the Treasury Department, shall obtain the gold and silver bars it may consider proper for storage or coinage at the mint.

Art. 6. The importation of domestic or foreign gold in bars or coin is exempt from the payment of consular fees and consular invoice charges.

Another telegram from the American Ambassador, dated March 21, states that, according to an announcement appearing in the press, the Treasury Department has given instructions to all customs-houses and tax-collecting officials in Mexico not to receive paper currency of the United States in payment of duties or taxes. (A similar order directing that American paper, or silver, or bills of exchange on the United States should not be accepted in payment of Federal duties and taxes, was issued in September 1917, and was also referred to in 'Commerce Reports' of October 1, 1917).

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

E. L. Dufourcq is in Mexico.

H. Foster Bain is at Washington.

James M. Hyde has gone to Washington.

J. P. Graves, of Spokane, is at the Fairmont hotel.

Donald M. Palmer is with the Chino Copper Co., in New Mexico.

A. H. Higgins, of Minerals Separation Ltd., has gone to Arizona.

C. Gore-Langton is with the Du Pont Nitrate Co. at Iquique, Chile.

Augustus Locke has returned to San Francisco from Durango, Mexico.

Chester F. Lee was in San Francisco for a few days on his return from Nevada to Seattle.

Carlos Billick is in the Ordnance Department, U. S. N. A., stationed at Alturas, California.

W. L. Williamson has been made superintendent of the Allison Ranch mine at Grass Valley.

Jackson A. Pearce, formerly at Idaho Springs, Colorado, is now residing at Berkeley, California.

Robert W. Jones has been appointed inspector of mines and tunnels for the State of New York.

D. C. Bard, consulting engineer to the Ladysmith Copper Corporation, has returned from Alaska.

Henry E. Wood passed through San Francisco on his return from southern California to Denver.

A. G. Wolf has been appointed superintendent of the Mary Murphy mine at Romley, Colorado.

N. M. Muir is engaged on work relating to the recovery of gasoline contained in natural gas in Oklahoma.

Guy C. Riddell has returned from Australia and is now metallurgical expert to the U. S. Tariff Commission.

H. O. Hammond has been appointed chief chemist for the United Verde Extension Mines Co., at Jerome, Arizona.

J. W. Hutchinson, general manager for the Goldfield Consolidated Mines, has resigned in order to engage in patriotic service.

Richard Roelofs has resigned as superintendent for the Cresson Consolidated at Cripple Creek and is now at Los Angeles.

A. R. Globe, formerly at Kimberley, South Africa, has been appointed assistant general manager of the Hollinger Consolidated at Porcupine.

J. O. Greenan, superintendent of the Olympic mine, in Nevada, has volunteered for service with the 27th Engineers and has gone to Fort Douglas, Utah.

R. H. Stewart has entered into partnership with **A. G. Larson** and **Arthur Lakes**, as consulting mining engineers, with offices at Vancouver and Spokane.

W. W. Mein has been placed in charge of the fertilizer branch of the U. S. Department of Agriculture, as "immediate representative" of the Secretary of Agriculture.

Barclay Bunthrone, representing Lewis & Marks, Lord D'Abernon, and other British capitalists interested in mines in British Columbia and Mexico, was killed in a motor-accident at Oakland, California, on March 27.

Rudolf Gahl has resigned as metallurgist to the Inspiration Consolidated Copper Co. and is succeeded by **Guy H. Ruggles**, lately mill-superintendent for the Consolidated Arizona Smelting Co. at Humboldt, Arizona. Dr. Gahl will engage in consulting work, continuing to reside in the Globe-Miami district.

THE METAL MARKET



METAL PRICES

San Francisco, April 9

Aluminum-dust (100-lb. lots), cents per pound	70
Aluminum-dust (ton lots), cents per pound	65
Antimony, cents per pound	15½
Antimony (wholesale) cents per pound	13¼
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7½— 8½
Nickel, cents per pound	55
Platinum, pure and with 10% iridium, per ounce	$108—$116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	10
Zinc-dust, cents per pound	17½

Antimony smelting in China, which country supplies 60% of the world's output of this metal, is fully described by Chung Yu Wang in a paper prepared for the Colorado meeting of the A. I. M. E. The antimony industry of China started in 1897.

Bismuth in England is now under Government control, only certain quantities being allowed dealers and manufacturers.

Nickel prices—as arranged by the Government and the International Nickel Co.—have been fixed at 40c. per lb. for the best grade and 38c. for the lower grade.

ORE PRICES

San Francisco, April 9

Antimony, 45% metal, per unit	$1.10
Chrome, 38% and over, f.o.b. Cal., per unit	$1.25
Magnesite, crude, per ton	$8.00—10.00
Manganese, 40%, at Heroult, Cal., cents per unit (long ton)	75
Manganese, chemical, per ton	$80—100
Tungsten, 60% WO_3, per unit	$20— 24
Molybdenite, per lb., 85% MoS_2 (nominal)	$1.80
Pyrites, domestic, per unit of sulphur, cents	28

The magnesite market is practically dead.

Manganese imports are declining. In January there was 42,947 tons landed, against 49,530 tons a year ago; and in 7 months ended January 31, 1918, a total of 356,129 tons, compared with 388,828 tons in the previous period.

The possible treatment of manganese ores in California is thoroughly discussed by E. A. Hersam in Vol. 2, No. 1, pages 1 to 56, of the University of California publications. There appears abundant reason why these low-grade deposits should be developed. Manganese producers should study this investigation.

EASTERN METAL MARKET

(By wire from New York)

April 9.—Copper is quiet. Lead is inactive, though steady. Spelter is quiet and lower.

SILVER

Below are given the average New York quotations, in cents per ounce, of fine silver. For San Francisco prices add 3 cents per ounce.

Date		Average week ending	
Apr.	3 — 92.12	Feb. 26	85.30
"	4 — 91.87	Mch. 5	85.12
"	5 — 91.87	" 12	85.66
"	6 — 91.62	" 19	86.71
"	7 Sunday	" 26	91.27
"	8 — 91.62	Apr. 2	92.12
"	9 — 91.37	" 9	91.74

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

COPPER

Prices of electrolytic in New York, in cents per pound.

Date		Average week ending	
Apr.	3 — 23.50	Feb. 26	23.50
"	4 — 23.50	Mch. 5	23.50
"	5 — 23.50	" 12	23.50
"	6 — 23.50	" 19	23.50
"	7 Sunday	" 26	23.50
"	8 — 23.50	Apr. 2	23.50
"	9 — 23.50	" 9	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Copper refineries and mining companies have, in a number of cases, readjusted contracts. Prior to the War, contracts were based on prices ranging from $14 to $17 per ton. Old contracts have been renewed at $25, and new contracts at $35 per ton.

Brass exports from United States in 1917 were valued at $239,857,967, a decrease of $75,798,790 compared with the previous year. Common brass contains 64% copper.

LEAD

Lead is quoted in cents per pound, New York delivery.

Date		Average week ending	
Apr.	3 — 7.20	Feb. 26	7.10
"	4 — 7.20	Mch. 5	7.33
"	5 — 7.20	" 12	7.25
"	6 — 7.20	" 19	7.25
"	7 Sunday	" 26	7.25
"	8 — 7.00	Apr. 2	7.19
"	9 — 7.00	" 9	7.13

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Mch.	12 — 115.00	Mch. 26	115.00
"	19 — 115.00	Apr. 2	105.00
		" 9	115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	....	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

It is reported that the Government has issued an order to quicksilver producers to hold, subject to its requirements, a tentative 40% of their total output, the exact amount to be decided later.

Mercury consumed at the six mills of the Homestake company, South Dakota, in 1917, cost $41,700, which, at the average of about $106 per flask last year, equalled nearly 400 flasks.

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Spot tin is scarce. No Straits or Banka metal is available in open market, only Bolivian and Chinese. In domestic trade dealers quote from 88 to 93c. If Straits were procurable it would be $1 per lb. National Lead Co. has completed a tin smelter at Jamaica bay, Long Island, N. Y. Company is connected with Williams, Harvey & Co. of England. Ore will come from Bolivia.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Apr.	3 — 7.25	Feb. 26	8.00
"	4 — 7.25	Mch. 5	7.91
"	5 — 7.25	" 12	7.79
"	6 — 7.25	" 19	7.75
"	7 Sunday	" 26	7.56
"	8 — 7.25	Apr. 2	7.33
"	9 — 7.12	" 9	7.23

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Zinc-ore prices at Joplin, Missouri, dropped $2.50 per ton last week. Business was done at $60, $47.50, $45, and $40 per ton for four grades. Calamine sold at $30 to $35 per ton, basis 40% metal.

Eastern Metal Market

New York, April 3.

Inactivity is generally characteristic of all markets; in some an easier tendency has developed into weakness.

There has been no change in any department of the copper market.

Tin transactions are restricted, despite a good demand.

Lead is much less active than for some time, and is lower.

Zinc has developed decided weakness, and is lower.

Antimony has declined on small dealings.

The feature of the iron and steel market is the remarkable recovery made in pig-iron output in March over January and February. The total was 3,213,091 gross tons, or 103,648 tons per day, against 2,319,399 tons in the 28 days of Fubruary, or 82,835 tons per day. Coke supply has increased, enabling more furnaces to operate, the month's net gain having been 24. The 344 coke iron furnaces in blast on April 1 were producing at the rate of 106,500 tons per day, which compares with the 1917 average of 105,000 tons per day. Three new modern blast-furnaces were blown-in last month. Government needs figure so largely in steel consumption that ordinary consumption has become incidental. A total of 1,000,000 tons of plates and 250,000 tons of shapes is estimated as needed to produce the pending 100,000 steel cars. The designing of standard freight-cars means that a good many patented car specialties will be omitted, disturbing some makers. Government rail requirements will add 300,000 tons, or more than 10% to the total that the railroads have already ordered for 1918.

COPPER

In the absence of any price changes or speculation, news is at times also a scarcity—more so this week than for some time. The market has subsided to one of regulated procedure as to price and material. It is a question almost entirely of supply and demand. These are now generally regarded as about balanced, with production fast approaching a rate of 200,000,000 lb. per month. Labor is the only retarding influence, and the new draft may accentuate it. Deliveries of raw metal to Eastern refineries are reported as much more satisfactory, which of course promotes output. Consumption is tremendous for international war purposes here and abroad. Domestic consumption for non-essentials is not large, as most copper-consuming industries are directly or indirectly engaged in war work. Exports continue on a large scale, those for March being estimated at 40,000 gross tons, a little larger than those in February. The Government prices of 23.50c. per lb. for carload lots and larger, and of 24.67½c. for less, are in force until June 1. As to a revision for higher prices, less is heard, with opinion divided as to the justice or any probability of such.

TIN

Considerable interest is shown here as to the effect of the seizure of Dutch vessels on receipts of Banca and Dutch tin in American ports. Indications are that the Netherlands government will use this as a club to exact certain concessions from the United States. Dutch tin imports constitute an important proportion of our supplies, and any loss of these would intensify an already critical situation. The market as a whole is unchanged from last week. There are numerous buyers of future metal, but sellers are few. The scarcity of those willing to sell is still as pronounced as a week ago, when it was emphasized in our letter. It is hard for buyers to obtain supplies, but if the metal were offered in quantity it could be sold without trouble. Spot metal is unobtainable, but is regarded as nominal at 85c., New York. Last week a moderate business was reported, consisting largely of May-June shipment from the Far East. Cables continue greatly delayed which, together with the scarcity of sellers, accounts for the light trading. Arrivals in March totaled 1700 tons, and the estimated quantity afloat is about 6300 tons. Stocks in store and landing on March 31 were only 134 tons, indicating how low spot metal actually has declined. The first of each month used to show 2000 to 2500 tons. The London market is unchanged since a week ago when spot Straits was quoted at £317 10s.

LEAD

In New York and the East the market has been and is very quiet. It is also slightly easier, with quotations a little lower than a week ago, or 7.15 to 7.20c., New York, and 7c., St. Louis. Very little business is reported. In the West the situation is a little different. Some reports are to the effect that lead has been offered and sold at 7c., but it is believed that the volume was not large. The entire market is a drifting easy one. The A. S. & R. Co. is still quoting 7.25c., New York, but some believe a reduction in the near future not unlikely.

ZINC

The market has continued to sag on offerings from certain sources, and quotations are lower than for many months. Yesterday prime Western for April delivery was quoted and sold at 7c., St. Louis, or 7.25., New York. It is understood that sales have been made at this level for even May and June delivery. In either case the amount involved has not been large, though some 100-ton lots have changed hands. The cause of the weakness is probably due to the keen desire of a few interests to obtain cash. It is also suggested that it may result in some smelters suspending operations. For many, if not the majority, it is claimed there is a loss at present prices. The net result is expected to be a curtailment in output and not a large stimulus to consumption. Until the supply is less than the demand, or at least not greatly in excess, as at present, a firmer market is not expected. Grade A continues in large demand by the Government, which has a fixed price of 12c. per pound.

Sheet zinc is officially pegged at 15c., base.

ANTIMONY

The market is lower at 13c., New York, duty paid, for Chinese and Japanese grades, with sales of small consequence and demand light. Antimony imports in January, according to statistics just issued, were low, or 1,186,361 lb. compared with 2,036,029 lb. a year ago. This covers regulus and metal in ore and matte. Imports were only one-third of the average of the last six months of 1917.

ORES

Molybdenum: The market is inactive at unchanged prices. Prospective foreign orders for ferro-molybdenum may enliven the situation.

Tungsten: Activity has pervaded the market during the last week, and concentrates have sold at $20 to $24.50 per unit, basis 60% WO_3, depending on quality and delivery. High-grade wolframite has brought $24, and scheelite, $24.50. Embargoes are still retarding shipments. Ferro-tungsten is obtainable at $2.25 to $2.40 per pound of contained tungsten. The demand for tool-steel is sure to be greatly increased, due to nearly $30,000,000 of ordnance and machine-tools to be made.

Company Reports

IRON CAP COPPER CO.

Property: mine at Globe, Arizona, adjoining Arizona Commercial and Old Dominion.

Operating Official: F. A. Woodward, superintendent.

Financial Statement: surplus on January 1, 1918, was $237,502.

Development: the Williams shaft was sunk 128 ft. to depth of 1083 ft. The Iron Cap shaft was sunk to 15 ft. below No. 10 level, where a cross-cut passed through the vein in January 1918, showing good bornite ore. On 800-ft. level, drifts have opened the vein for 600 ft., mostly commercial. Stopes for 406 ft. are 10 ft. wide. On No. 9 level stopes are out 372 ft. These two levels are supplying over 200 tons of ore daily. No. 7 shows little ore.

Production: 20,989 tons of ore to El Paso smelter and 10,631 tons to Old Dominion mill yielded 4,584,000 lb. copper and 145,788 oz. silver.

WELLINGTON MINES CO.

Property: zinc mine and mill in Breckenridge district, Colorado.

Operating Officials: R. M. Henderson, general manager; C. Charpiot, secretary.

Financial Statement: receipts from all sources in year ended November 30, 1917, totaled $1,102,107, of which $1,069,969 was from concentrate sold. Operating charges were $464,696. Period started with balance of $227,799, and ended with $375,211, plus $90,000 in Liberty Bonds.

Dividends: sum of $400,000 was paid in 1917, making $1,300,000 in three years.

Development: new work covered 3453 ft. Main shaft was sunk 150 ft. below No. 5 level. A 450-gal. per min. pump was installed. Great Northern vein produced all the ore.

Production: 41,900 tons of ore assaying 24.5% zinc was milled, yielding 20,420 tons of 46% concentrate; 6179 tons of 43% ore was sent direct to smelters, with 7650 tons of low-grade iron-bearing tailing.

HOLLINGER CONSOLIDATED GOLD MINES, LTD.

Property: large gold mine and mill at Porcupine, Ontario.

Financial Statement: for year ended December 31, 1917, revenue totaled $4,271,260, of which $4,261,939 was from gold produced. Operations cost $2,261,711, leaving $2,009,548, less $289,234 for taxes, depreciation, etc. The year started with a deficit of $269,591, which was wiped out. Plant expenditure was $673,238. Surplus is $712,724, consisting of cash, bonds, bullion, and debentures. Current assets and bullion exceed liabilities by $798,293.

Dividends: $738,000 was distributed in 1917, making $8,194,000 to date, since 1912, including consolidated companies. Payments were suspended last year, but may be resumed soon.

Development: new openings totaled 29,696 ft., in addition to 8024 ft. of diamond-drilling. Development cost $131,224 in 1917, making $1,412,462 since 1910. Shortage of labor retarded progress, and present 750 miners is 66% of normal requirements. Mining cost increased from $2.17 to $3.51 per ton. Ore-reserves in 38 main veins and on surface are estimated at 4,494,510 tons, averaging $8.95 per ton. Total value of $40,231,435 is $6,045,900 more than a year ago, although $4,261,939 was extracted during 1917. These reserves are mostly above 800-ft. level. Work is under way at depth of 1250 feet.

Production: the 2500-ton mill treated 508,139 tons of $8.67 ore and 6162 tons of old concentrate worth $7.71 per ton. Extraction was 95.16%. Output to date is $19,728,383 from 1,950,121 tons treated.

Costs: averaged $2.959 for mining, $1.017 for treatment, and $0.463 for general charges, a total of $4.439 per ton.

SAN TOY MINING CO.

Property: silver-lead mines in Santa Eulalia district, Chihuahua, Mexico; and through a subsidiary, the Lawrence Mining Co., controls the Bonney property near Lordsburg, New Mexico; also an interest in 300 acres of zinc land at Ozark, Missouri.

Financial Statement: income in 1917 totaled $26,715, of which $20,850 was from rentals. Expenses were $33,292, leaving a deficit of $6577. Balance at January 1, 1917, was $322,639, and at December 31, 1917, $316,062.

Development: Mexican property has been leased to the Compañia de Minerales y Metales for 10 years, on royalty of 15% on net smelter returns, minimum to be $300,000, payable monthly in advance in instalments of $2500. At Lordsburg No. 2 shaft was sunk to 450 ft. depth. Development on this level has been good. From upper levels, 6800 tons of ore, yielding $9.20 per ton net from smelter, was mined. High costs left no profit, so in August production was suspended. A permanent power-plant is to be ordered. When erected, ore extraction will be resumed. At Ozark, mill repairs and development occupied the time from July to December. Prospects are considered satisfactory.

NATOMAS COMPANY OF CALIFORNIA

Property: over 15,000 acres of dredging land near Folsom and Oroville, also over 70,000 acres of farm lands in Sacramento county, California. Equipment includes 13 large modern electrically-driven dredges; two rock-crushing plants; and land-reclamation machinery.

Operating Officials: Emery Oliver, general manager.

Financial Statement: gross earnings from dredges in 1917 was $2,303,544, of which $1,099,309 was profit. Non-operating expenditures (bond redemptions, notes payable, sinking-fund deposits, No. 5 dredge construction, and reclamation projects) totaled $1,204,464. Current assets are placed at $1,165,698, and current liabilities $185,993. After charging during 3 years $2,741,295 for exhaustion of dredging ground and depreciation of plant, there was a deficit of $763,527. All properties are valued at $17,222,399. Mortgage and bonded debt stands at $10,640,835. Total cost of reclamation work in both districts is $4,455,000. District No. 1000 is finished. Lands sold to March 19, 1918, amount to 9391 acres, realizing $2,727,861.

Development: reserves of gravel are estimated as 247,200,000 cubic yards. No. 1 dredge near Oroville dug old ground in 1917, making a profit of $67,648. No. 1 and 4, near Natoma, are re-soiling the land successfully. Drainage-canals in No. 1000 district total 130 miles, and roads 116 miles.

Production: all dredges dug a total of 27,106,000 cu. yd., averaging 8.5c. per yd., at cost of 4.4c. per yard. The crushing-plants produced 435,351 tons of crushed rock, 53,635 tons of washed gravel, and 157,430 tons of screened gravel.

CORDOBA COPPER CO.

Property: mines and works near Cordoba, Spain.

Operating Official: James Hocking, superintendent.

Financial Statement: in 1917 sales of copper, etc., realized £193,615. Profit was only £13,513, due to abnormal conditions.

Development: 2118 ft., against 6821 ft. in 1916. Results were disappointing. Reserves are 99,139 tons of 2.16% ore.

Production: concentrator and smelter treated 61,373 tons of ore assaying 2.77% copper, yielding 3,480,960 pounds.



INFORMATION FURNISHED BY MANUFACTURERS

STEEL MINE-TIMBERS

Steel mine-timbering has been slow in winning public favor, but its use is steadily increasing. The earlier designs were defective in some respects, and they were not used with due regard to their limitations. The Carnegie Steel Co. has for a number of years made a specialty of steel shapes for underground use, it has just issued a seventh revised edition of an illustrated booklet on the subject, which will prove highly interesting to mine managers and foremen. The miner's objection to steel on the score of its rigidity is applicable only to stulls. It is true that no timbering can resist an extensive movement of rock-masses, and that the function of timbers is to prevent the beginning of movement. Resistance to it after it has begun to move may be effective if the mass readjust itself through fracturing and becoming keyed, and the doubling of posts and caps is done in the hope of such action taking place. In the mines at Butte enormous amounts of timber have been used with this object in view. The use of steel supports has not, to our knowledge, been successfully applied in square-sets for holding open large stopes, but in gangways the steel post and cap generally offers an advantage. When a post is broken it is useless; as soon as it begins to bend, it is crushing, and a new set must soon be placed to prevent a spill. The steel post or cap, however, can be drawn, and the open-hearth mild-steel shape admits of being straightened in the shop. It is then useful for further service as an auxiliary support, or as a stull. The steel will bend soon enough to reveal a movement before it becomes uncontrollable. In the early days steel columns for mine-work were made with the idea of rigidity sufficient to resist the actual movement. This was an error; a proper degree of flexibility is essential for safety, and the steel channels now employed are as satisfactory in that regard as timber. While still used mainly in permanent gangways, they are also in favor as stulls where the conditions favor their recovery after the ore or coal has been worked out. In some of the later adaptations of the caving method, as seen, for example, at the Miami mine in Arizona, steel sets have been found serviceable in the gangways on the drawing-off level, although these levels are progressively lost as caving proceeds. Here they seem to be more reliable than timber because they yield under the crush of the ore in time to prevent a sudden collapse, and by resisting better than timber they afford opportunity for the slower movement of the caving ore, which causes better disintegration, that is, it yields less blocky material that would choke the chutes and require block-holing. The recovery of steel set-members under these conditions is quite satisfactory. The question, of course, is one of economy; it depends primarily upon the relative. Costs of steel and timber at any particular property delivered in the mine, taking into account the cost of cutting and fitting the timbers, the extra weight, bulkiness, and difficulty of handling, as against the greater ease of transporting the steel set-members. Also, there is a difference in the cube of excavation to give the needed section in the level. In the older forms of steel sets there was no flexibility in adjustment, but this is overcome by pine and wedges at the joint. Rigidity of the posts is secured by pipe-separators, and posts are placed on steel base-plates. The mine is not filled with chips and decaying wood when steel is employed; it means

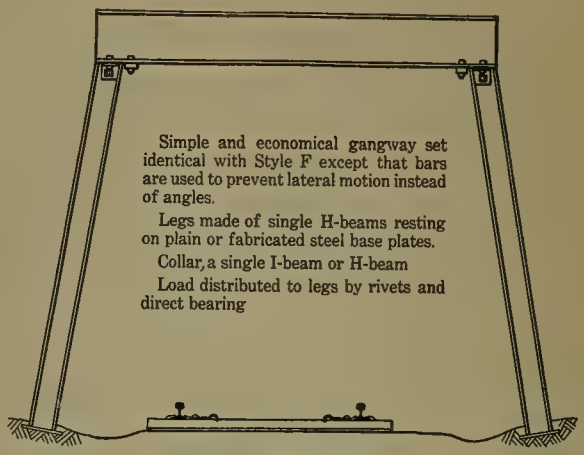


Fig. 1—Gangway Set, Style G

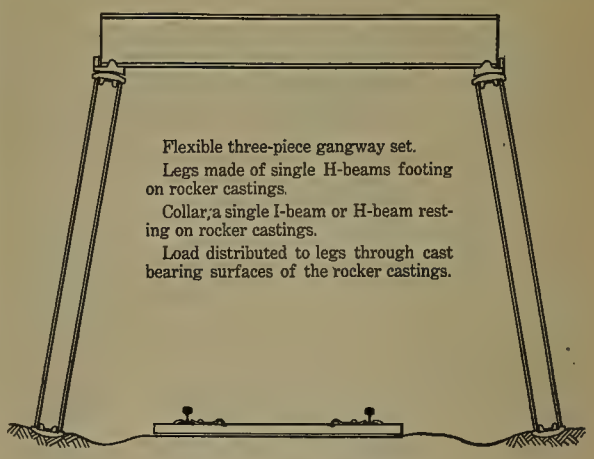


Fig. 2—Gangway Set, Style I

REPRESENTATIVE GANGWAY SETS WITH H-BEAM LEGS

better air, and healthier conditions; the peril of fire is eliminated, and the workmen will make a stronger effort to recover steel-sets from old workings, so that the salvage is greater.

Proper Design of Steel Mine-Timbers. The cost of a durable material may be much enhanced by improper methods in its preparation for final use. Details of framing should be simple and connections should be of minimum

weight so that the cost of fabrication may be the least possible consistent with good engineering practice. Above all, the kind of steel sections to be used should be chosen with a view to the character of stresses so as to ensure proper and most economical distribution of the loading.

Fig. 1 and 2 show designs of merit for three-piece gangway-sets. Either of these might be adequate for use under any given loading. When adjusted, however, to the same loads, the same spans and the same clear heights, their costs differ widely. Assume that it is desired to substitute steel for a three-piece double-track gangway-set made with 15-in. round yellow-pine timbers, the legs of which are 8 ft. high in clear and the collar 10 ft. long between legs, and that the steel is to carry the full load of seasoned timber: The figures given in the table show the comparison for a single-track gangway-set. Framed in steel of strength equivalent to seasoned wood timbers, the collar would be a 10-in. 25-lb. I-beam and the legs each either a single 5-in. 18.7-lb. H-beam or two 6-in. 10.5-lb. channels.

Comparative Costs of Steel Mine-Timbers

Single-track gangway-supports—10-ft. span, 6 ft. high.

Style	Figure No.	Cost per set: Without base, lb.	Cost per set: With base, lb.	Weight per set: Without base-plates, per set	Weight per set: With base-plates, per set	Cost per pound: Without base-plates, per lb., cents	Cost per pound: With base-plates, per lb., cents
A	1	765	945	$17.48	$26.47	2.29	2.80
B	2	765	810	17.48	18.95	2.29	2.34
D	3	765	800	17.48	18.65	2.29	2.33
E	4	605	660	11.50	13.20	1.90	2.00
C	5	565	605	9.88	11.15	1.75	1.84
F	6	569	590	10.84	11.49	1.90	1.95
G	7	566	587	10.78	11.44	1.91	1.95
I	8	600	630	11.90	13.30	1.98	2.11

The figures given in both are for material not painted. If painted, one shop-coat of the usual shop-mixture, the cost would be $2 per net ton additional throughout. The figures in both comparisons are based on plain structural steel at $1.60 per 100 lb. f.o.b. cars, Pittsburgh, Pennsylvania, taken as a fair normal price. The cost per set can be adjusted to any other basis by the simple addition or subtraction of the weight multiplied by the price differential. Variable conditions make it difficult to compare the cost of steel and wood mine-timbers except on the basis of specific instances. As a general rule, when consideration is had to depreciation and ultimate expenditure, the operator can afford to pay for correctly designed steel sets three to four times the cost of wood-sets of equivalent strength. In a few cases steel has even been substituted for wood at almost equal cost prices.

Comparisons should always be based on first cost, length of service, cost of renewal and maintenance and interest on total investment. Consideration should also be had to such apparently extraneous matters as ventilation, fire risk, and interruption of operation when wooden timbers come to be renewed.

Stresses in Mine-Timbers. In the use of steel for timbering, the safe guide is experience. The exact amount and exact direction of the pressures exerted by roof, walls, and floor are in many cases indeterminate. General principles only can be stated. The interpretation of these principles must rest upon experience and analogy. Where steel is to replace wood, the problem of the designer is to select from the tables the steel sections equivalent in strength to the wooden timbers which are in use and then to work out connections and other details so as to ensure a minimum cost of fabrication. If experience indicates the wood timbers to be too light, if they fail from over-strain rather than decay, the steel sections should be made somewhat heavier than required by the tables so as to cover that over-strain. The strength of an assemblement is the strength of its weakest member. In a three-piece gangway-set each leg seldom carries more than half the load on the collar, and in most cases needs only to be proportioned thereto. Where this method of computation loads a leg to its full theoretical value, it is customary to use the next heavier section to provide against cross-bending due to the wedging, weight of lagging, and other indeterminate factors. In new work it is safest to use somewhat heavier sections than required by the rules.

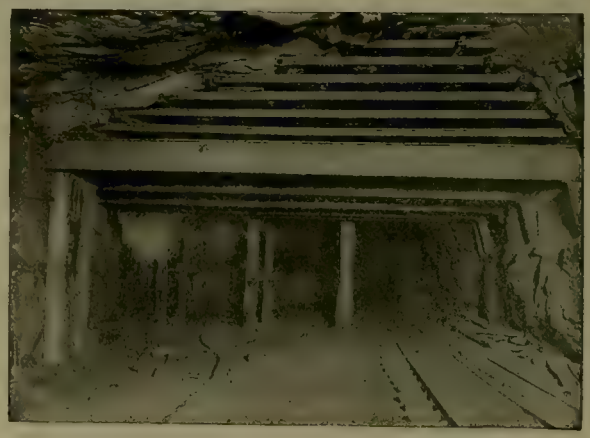
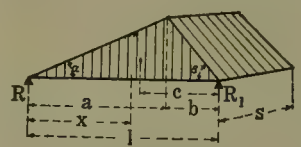


FIG. 3—ACTUAL ROCK CLEAVAGE, INCLINED STRATA

Fig. 3 shows the common condition where the strata are inclined, where the cleavage is not symmetrical, and arch is fashioned but irregular. In this case the apex of cleavage is nearer one end of the collar than the other. The magnitude of the load is computed, as in the case of symmetrical cleavage, from the weight of the cleavage prismoid. The centre of gravity of the load must be determined and from that basis the maximum bending moment can be computed. If the apex of the cleavage prismoid is over a support, the maximum bending-moment is the same as for a beam loaded with a load increasing uniformly to the centre. The values of M max. will, therefore, range within these two limits; that is, from 0.1287 Wl to 0.1667 Wl, but can be computed exactly from the formula given in Fig. 4.



$$W = \frac{swl\,(a \tan \alpha)}{2}$$

$$R = \frac{Wc}{1} \qquad R_1 = \frac{W\,(1-c)}{1}$$

$$c \text{ (centre of gravity)} = \tfrac{1}{3}\left(1 + \frac{a \tan \alpha}{\tan \beta}\right)$$

$$\text{M, distance x} = \frac{W\,(3\,cax - x^3)}{3\,al}$$

$$\text{M max., distance } \sqrt{ca} = \frac{2\,Wc\,\sqrt{ca}}{3l}$$

FIG. 4—FLEXURE FORMULA, UNSYMMETRICAL LOADING

The loads on the two legs are not equal and in their design the more exact solution of the problem should be made and the reaction at each end of the beam computed in accordance with the formula.

Fig. 5 shows a typical five-compartment mine-shaft framed exclusively in steel, and lagged with wooden plank, concrete slabs, or currugated iron. The shaft-sets are made of H-beams and the stuttles are made of angles whose use secures stiffness, while at the same time it dispenses with the hanging-rods necessary in the installation of wooden sets. With this type of construction the load is distributed equally on the bearers above and below. The advantage of the H-beam wall-plate over other forms of steel-sections is that it provides ample bearing against the sides of the shaft, together with sufficient strength to take care of any bending stresses due to the settling of the strata, whil it is also admirably adapted to resist compression from the action of the shaft-walls on the wall plates.

Owing to the readiness with which it may be molded to form, reinforced concrete is the best material for the construction of elliptical shafts. Steel lends itself more readily to the construction of rectangular shafts, and in that way is the exact substitute for wood. The Carnegie Steel Co. does not furnish steel mine-timbering fabricated ready for use in shaft-work. Quotations, however, will be made by the American Bridge Company.

Inasmuch as steel mine-timbers are fabricated complete in the shop, they are ready for erection when they reach the mine-face, and no further cutting or fitting is necessary. Erection, therefore, is quite simple, and no other tools are needed than wrenches. The usual method of erection is to assemble the three pieces complete on the floor, bolt the connections together, and raise the set into position, either by main strength or by a line thrown over the collar and attached to a snatch-block fastened at some convenient



FIG. 5—TYPICAL RECTANGULAR STEEL-FRAMED MINE-SHAFT

point. Three-piece gangway-sets have been erected complete and wedged in place in eight minutes.

Preservation of Steel Mine-Timbers. The economical use of steel in mines requires a like degree of care for its preservation as accompanies its use above ground, although conditions underground are not nearly so severe, as the steel is not exposed to alternations of high and low temperatures, dryness and wetness, strong light and darkness. The base-plates should be set in the dry. Where they come on the edges of ditches, it may be desirable to set them on low concrete piers. All steel in mines should be well painted and kept painted. The pigments should be good and applied with care. Carbon paints in whose manufacture sulphuric acid has been used, and oxides of iron manufactured by chemical processes, or recovered as a by-product of metallurgical processes, are to be avoided. A metallic paint should be used for the first or shop-coat by reason of its adhesive qualities. The second coat should be a moisture excluder.

For the best service it is recommended that the steel be painted at the shop with a mixture of red lead, oil, and asbestine, in the proportion of 15 lb. of red lead and 2 lb. of asbestine per gallon of pure raw linseed oil, with sufficient japan dryer to work well; and that a first-class graphite-paint be applied thoroughly as a field or second coat to protect the shop-coat and to fill up any vacancies or voids. The theory which underlies this recommendation is the use of practically inhibitive pigment to prevent the inception of corrosion in the steel, and the use of a second coat to protect the first from atmospheric and temperature conditions. Re-painting within the mines should be done on clean surfaces, absolutely free from rust, paint-skins, or dirt. It is not sufficient to apply a new coat of paint over an old paint-surface under which traces of corrosion already appear.

The book is handsomely illustrated, and is replete with tables showing elements of structural sections, allowable loads on various shapes, weights, bolts, comparative tables for wooden columns, struts, beams, and the like, together with all the engineering data for making the needed calculations, and other useful tables.

MAKING A HARBOR

At the entrance port in France for our expeditionary forces the United States Engineering Army has transformed in the last six months what was then an insignificant shipping point, with facilities for only a half dozen vessels, into a harbor that rivals the greatest American port. Machinery and materials costing $40,000,000 were available. The engineers dredged the shallow channel and made a deep water-way. The debris filled in marshes that were covered with miles of piers and warehouses. Now 60 steamers can load and discharge their cargoes at one time. The largest railroad yard in France has made the war zone tributary to this port. Miles of switches and hundreds of train-crews are busy handling the food and supplies for the Army. Shops and round-houses are ready to keep the rolling-stock in good repair. Many battalions of engineers were required to build this distributing centre in so short a time. This new harbor was planned and the improvements were all made by engineering soldiers. Engineers are the pioneers of an army; they make the way possible for the advance of infantry and artillery; they are the skilled workmen of the army. The First Replacement Regiment of Engineers, stationed at Washington Barracks, D. C., trains men for the different organizations of the United States Engineers. The personnel of units in the Engineering Army is similar to that of an industrial organization. Each man in the army applies his technical knowledge to solving military problems. A soldier can follow his chosen profession in the army as well as the man in the industrial world.

HIGH EFFICIENCIES IN MOTOR-DRIVEN WATER-WORKS PUMPS

Many pumping problems are most conveniently solved by electric-driven pumps. Such pumps are a peculiarly desirable load for central stations, as they operate either at full load continuously, or in some cases are operated only during periods of light load, thus helping to fill up the 'valleys' in the load curve. Where centrifugal pumps are operated by power purchased through a meter, careful attention is likely to be given to efficiency, as a slight gain in efficiency will in a short time amount to more than the cost of the pumps.

Equipment recently installed at the McCarren pumping station of the St. Paul water department, included two 12-in. motor-driven centrifugal pumps. The specifications required that each unit should be guaranteed to deliver not less than 5000 gal. per minute against a total head of 171 ft., and not more than 5500 gal. against a head of 158 ft., the overall efficiency from 'wire to water' to be not less than 72% when pumping continuously at either of the

heads and deliveries. It was further required that when delivering against a reduced head of 140 ft. the motor should not be overloaded. The bid of the Northwestern Electric Equipment Co., of St. Paul, which was accepted, offered pumps manufactured by the De Laval Steam Turbine Co., of Trenton, N. J., and synchronous motors of the rotating field type, manufactured by the Electric Machinery Co., of Minneapolis. These were guaranteed an efficiency of 74.3% at heads of either 158 or 171 ft., and an overall efficiency of 73.7% at 140 ft. The motors receive three-phase, 60-cycle current at approximately 2200 volts, and drive the pumps at 1200 r.p.m. They are so designed that they can be started by the application of alternating current to the armature windings. In normal operation they are supplied with exciting current by direct-connected exciters of 1¾-kw. capacity. The pumps are of the De Laval single-stage double-suction volute type, having 12-in. suction and discharge-nozzles. No diffusing vanes are used.

After erection, both units were subjected to complete tests to determine both efficiency and head-capacity characteristics. Before the official tests were run the impellers had been turned down slightly in diameter, due to the fact that the motors were operating at 20 r.p.m. above rated speed. All instruments were carefully calibrated. The quantity of water delivered was measured by a 30 by 13-in. Venturi meter, supplied by the Builders Iron Foundry Co., of Providence, R. I.

On motor No. 403,115 the following efficiencies were obtained: full load, 95.5%; ¾ load, 94.9%; ½ load, 93%; and on motor No. 403,129: full load, 95.3%; ¾ load, 94.6%; ½ load, 92.5%.

The efficiencies obtained on the pumps are high, considering the comparatively small capacity and the high head. Pump No. 25,651, at a capacity of 6527 g.p.m. shows an efficiency of 81.8%; and at 4097 g.p.m. an efficiency of 77%. Or, for a reduction in capacity of about 37%, there is a reduction in efficiency of only 5.9%, which must be considered very good for a centrifugal pump.

ROBB ENGINEERING WORKS, LTD.

The International Engineering Works, Ltd., has received authorization through letters patent of the Dominion of Canada to alter its name to the Robb Engineering Works, Ltd., under which title it will conduct its business in future. The organization of the company will remain as heretofore. The object of the change in title is to identify the business more closely with the established reputation of the Robb engines, boilers, and other products, known under that trade-name throughout Canada, the United States, and other countries. The concern is now engaged extensively in the manufacture of war-products, but it has not been neglectful of the needs of its former customers, and it has made a special effort to be in position at all times, so far as the war-demand will permit, to supply repair parts for the Robb engines and other equipment bearing the Robb name-plate. The company has adopted a policy of consideration toward private business, on liberal terms, keeping in view the certainty that the War will end some day, and that it will then be agreeable to have retained the goodwill of its former customers, and to be in a position to take advantage of the extensive development that is expected in the Canadian provinces. The circular announcing the new designation of the company has been issued over the signature of D. W. Robb, vice-president and general manager, Amherst, Nova Scotia.

'Duplex Doings' for March briefly describes various hard tests on machines made by the Duplex Truck Co. of Lansing, Michigan. Several feats in deep snow show what these trucks are capable of doing.

COMMERCIAL PARAGRAPHS

Bulletin 236 of the Walter A. Zelnicker Supply Co., of St. Louis, lists rails, locomotives, cars, tanks, and general machinery in stock.

American Refractories Co., manufacturers of chrome and magnesite brick, etc., has moved its head office from Joliet, Ill., to Union Arcade Bdg., Pittsburgh, Pa.

The Hyatt Roller Bearing Co., of New York, states that 21 big buildings at Newark, N. J., did not give its factory sufficient space for manufacturing bearings. They needed the building in which the firm was formerly situated, so the Industrial Bearing Division has been moved. The completely equipped engineering and sales offices are now in the Metropolitan tower, New York.

Tartarian & Pratt, of Los Angeles, California, have issued, for free distribution, a handy sheet of determination tables for commercial minerals, giving the characteristics of 65 species. A useful feature of the tables is a co-ordinate system for approximate identification of the mineral, based on the scale of hardness and the color of the streak. This particular form is original, and has been copyrighted by G. H. Pratt and H. V. Kleist.

Tierra del Fuego y Sus Turberas. By Guido Bonarelli. Anales de la Seccion Geología, Mineralogía y Minería del Ministro de Agricultura, Rep. Argentina, Tomo XII, Num. 3, 1917.

The Director of Mines of the Argentine Republic has just issued this bulletin, prepared by Dr. Bonarelli. As a geological study it is admirable, both from the matter presented and the manner of treatment. It is a scholarly discussion of peat on the island of Tierra del Fuego. It is, moreover, a scientific study of peat, viewed in its broad aspect as a "geological phenomenon of the present epoch," as the author aptly puts it. Accordingly, the relations of peat to both climate and geology are discussed in great detail, as a consequence of which the author has given an account of the geology of Tierra del Fuego, and it turns out an extremely illuminating contribution. His study of the great batholith, which is responsible for the formation of this archipelago, is an interesting exposition of the various processes involved in a batholithic invasion of the earth's crust, and will be of broad interest to geologists in general, as well as proving useful to economic geologists interested in the gold and other mineral deposits of the islands. Six distinct types of peat are recognized: that resulting from the sphagnum moss; that coming from accumulations of hypnum; the forest peat (turba de bosque); 'carex' peat, formed by the remains of many species of the family of sedges generally mixed with types of moss and water-plants; the cotton-grass peat, resulting from the marsh-sedge division of the cyperacea; and lastly the lagoon peat. The relation of some of these types to their geologic environment is shown to be a close one. Furthermore, the special qualities of the different types is also brought out, and the possibilities of utilizing some of them for obtaining fibre is significant of like possibilities elsewhere. The book is accompanied with an extensive bibliography, which adds to its interest and value.

Gold output of the Rand in February was 659,759 oz., compared with 721,321 oz. a year ago. The recent floods and a short month contributed to this decrease. At the beginning of March there ware 181,066 natives employed at the gold mines, a drop of 10,000 compared with this period of 1917, but a gain of 4640 over January 1918.

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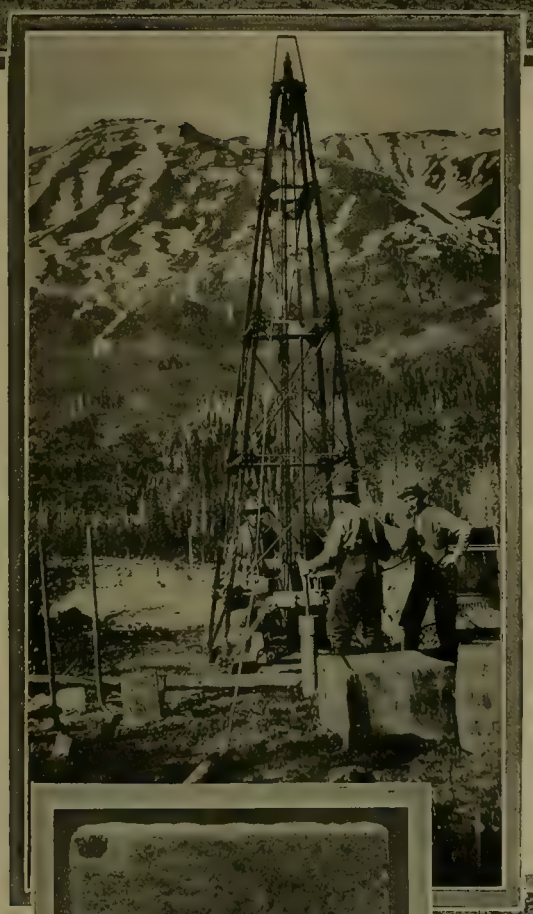
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UNION CHURN DRILL

Upper picture shows the drill being transported over forty-mile Alaskan trail.

Center picture—drill set up and drilling $6\frac{3}{8}$-in. diam. hole to a depth of 60 ft. at rate of 2 to $2\frac{1}{2}$ ft. per hour using $\frac{6}{10}$ gals. gasoline per hour.

Base picture shows drill being moved to next hole by drill-crew. Weight on wheels 2150 lbs.

Insert shows a block of granite, fifteen inches thick, with a $4\frac{3}{4}$-in. diameter hole drilled through in a demonstration. Time, one hour and fifteen minutes.

Every Drill Guaranteed

Bulletin, giving complete description, on request

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LISTS of honor are padded with the names of men engaged in civilian work. Thus the Institute's list of members "in military service" includes the gentlemen of the Naval Consulting Board, of the Fuel Administration, and the like. These men are doing patriotic work of unquestioned value, but it is a mistake to rank such service with that of the man who takes his place at the battle-front. Disguise it as we may, the supreme sacrifice is still that of risking one's life in fighting the enemy on the field of battle.

IS it not high time that all public feasting, drinking, and dancing cease, or be made to cease? In London or Paris there may be good reason for keeping restaurants and theatres open, for the gladdening of the gallant soldiers on leave, but for communities so far from the War as ours there is no excuse. If recruits need it, well enough; but the civilian population should show some realization of the fact that we are at the crisis of our fate; they can show it by abstaining from extravagant living and irresponsible gaiety.

PARTICIPATION of American capital in the development of the Rand goldfield is now assured by the acceptance of the tender for the lease of mineral rights on the Rietfontein West ground by the Anglo-American Corporation, to which we referred in our issue of November 24, 1917. At that time we stated that American capital in the corporation was represented by Mr. William B. Thompson, who is supported in this new departure by the Morgan and Rockefeller financial groups, who are acting with the Consolidated Mines Selection Company, identified in the minds of many of our readers with the names of Messrs. Walter McDermott and W. L. Honnold. The Rietfontein West undertaking involves a capital of $7,000,000 and the South African government is to be paid royalty on a sliding scale.

AMONG other methods for stimulating the production of the secondary minerals in California, the committee on geology and mineral resources organized under the State Council of Defense is exhibiting specimens of types of ore and of the rocks associated with them, so as to aid prospectors. Reference should be made to Professor George D. Louderback in the University of California, at Berkeley. Here we may mention the sinister fact that sundry deposits of useful ores, such as those of chrome, have been withdrawn from exploitation through purchases effected by German sympathizers, apparently to prevent production. Information concerning such cases should be given either to the Council of Defense, or, better, to the Intelligence Department of the U. S. Navy in San Francisco.

ANYTHING explaining conditions at the fighting front is keenly interesting at this time. We are particularly glad therefore to be able to publish a careful and illuminating article on the geography and geology of the Somme battlefield by Mr. Bailey Willis, Professor of Geology in Stanford University and head of the Mining Department in an institution that has contributed so many greatly useful men to the special work demanded by the War. Stanford has struck a strong clear note—like Harvard and Princeton—from the very beginning of this world crisis, and by doing so has proved herself, beyond anything measurable by mere money and numbers of students, a real university. Dr. Willis has been a close student of the military operations on the Western front, and in his article he gives the reader a simple straightforward description of the physical conditions modifying the movements of armies over the terrain that is now the scene of colossal conflict. The maps will be welcomed.

REQUESTS for information and advice come to us frequently, in person and by letter, from members of the profession desiring to offer their services to the Nation. To those that are of military age, that is, less than 40, we advise to enlist at once, for that is the direct way to effective service. This does not necessarily mean serving as a soldier in the trenches, but it does place the applicant on a proper footing with those in authority. As soon as a man enlists, he is asked to state his education and training, with a view to allocating him to the work for which he is best fitted. Every effort is being made to use men according to their special aptitudes; thus a chemist is likely to go into the ordnance department and a miner into an engineer regiment. Those that are too old for active service should apply through their friends, for personal character is of the greatest importance in recommending individuals for responsible positions. It is a pity that an information department for

volunteers has not been established in every large centre of population, but, in default of such a bureau, each man must do his best to find his proper job, and in seeking it he must retain his good temper, on which severe demands are likely. Where there is a will there is a way; no man need sulk in his tent if he be eager to serve.

'WILD-CATTING' is a term with a blemish that is hard to erase. We concede the significance of the contention offered in discussion this week by Mr. Walter Stalder. He avers that the over-production of oil in California for 1914-15 was achieved by 'wild-catting,' and that all past production was made possible only by such ventures. When an individual undertakes to drill a well where conservative operators anticipate no useful result, he may be dubbed a fool—until he wins—but he is not a 'wild-catter.' Depreciation is implied by that name; extravagant misrepresentation of the probabilities for purposes of stock-selling; the absence of frankly confessed pioneering. The world applauds initiative; it lies at the bottom of national growth; it is to be encouraged as a necessary virtue in a virile people; but to apply to it a discredited name is to discredit the thing itself. The company that denies or minimizes the risk when soliciting capital is a 'wild-cat,' but the honest venture deserves the meritorious title of 'pioneer' or 'prospector.'

THE hanging of the German, Robert P. Prager, at Collinsville, Illinois, was a hideous crime and a disgrace both to the State and to the Nation. All such acts of lawlessness, like the Bisbee and Butte affairs, are a blow at democratic government and should be reprobated by good citizens. No good, but much harm, comes of them. The people need not think that they can help the national cause or make America safer by assuming to mete out punishment beyond the pale of law. The Government has dealt with the German in our midst according to the light of the civilization that we profess, and in the spirit of the golden rule. It has offered the hand of fellowship and brotherhood, but, because it has been spurned so often, the righteous wrath of an outraged Nation is being shown in sterner methods and sterner laws. The sovereign will of the whole people shall be expressed, in a legal way, with ample energy and in ample time to prevent harm to our cause from those that are unmindful of their duty to a land that has welcomed and mothered them in the past. Meanwhile every good democrat will abide by the law.

THE Boletin Minero for January of this year, the official organ of the Department of Mines of Mexico, has just come to hand, and in it we find a long list of mining properties declared 'caduco,' that is, lapsed, applying to nearly every State in the Republic. It may be well for American owners of Mexican mines to scrutinize this list, which covers those declared forfeit from September 20 to November 16, 1917. The name of each property, its title-number, and its municipality are given. The same issue of the bulletin contains an official list of mining companies in Mexico that are in operation at the present time. The showing is larger than the reality, for the properties reported as operating in 19 different States are in a great many cases doing only as much work as may be necessary to avert confiscation. Without sufficient rolling-stock on the railroads, with no means for obtaining necessary supplies nor for shipping ores steadily and in large quantity, save as facilities of transport are afforded when possible by the two leading smelting concerns, it is not feasible for mines to produce on a scale approximating the normal.

REFERRING again to the American Metal Company and its German control, it is noteworthy that early this year five directors were appointed by the Government to represent the stock that had been taken in charge, soon after the United States declared war, by the custodian of alien-enemy property, Mr. A. Mitchell Palmer. These directors are Henry Morgenthau, George McAneny, Lewis L. Clark, E. C. Converse, and A. W. Mellon. Mr. Morgenthau was born in Germany, but he came to the United States when a child and has served his adopted country in various ways, the most recent being as ambassador to Turkey. He is a lawyer by profession. Mr. Converse is a prominent financier, identified with the Guaranty Trust Company, the United States Steel Corporation, the Inspiration Consolidated Copper Company, and other notable enterprises; Mr. McAneny is executive manager for the New York 'Times'; Mr. Mellon is president of the Mellon National Bank of Pittsburgh; Mr. Clark is president of the American Exchange National Bank, New York, and a director of many enterprises, including the New York and Honduras Rosario Mining Company. It is significant that Mr. Kuno B. Heberlein has resigned as president of the Compañia de Minerales y Metales and of other Mexican subsidiaries of the American Metal Company. He is reputed to be a trusty American and we presume that his resignation is in the nature of a protest against the inimical action of his co-directors in Mexico. As regards the South American connections of the American Metal Company, we are informed on the best authority that the Ore Trading Company, at Santiago, for example, is German from top to bottom, but that by way of camouflage it is registered in London as a British company. The London firm of Henry R. Merton & Company, with which the American Metal Company was closely allied, got into trouble with the British government early in the War and was compelled to re-organize, the German holdings being acquired by English capitalists, so that now the firm is wholly non-German. It is a pity that the name was retained, for that links it still with the Mertons (real name Cohen), of Frankfort, and the Metallgesellschaft, and fails to make it clear that the firm is now in the hands of Messrs. H. Gardner, H. A. Barton, Robert S. Lindley, and other Englishmen. The War is exercising a profound influence on the control of the international metal-market, and before it is over we expect to see further changes, not only of nationality, but, what is more important, of combination in restraint of trade.

The Crisis

At a moment like this, when the destiny of nations is in the balance and our own kith and kin are holding the line against the concentrated attack of the Enemy, it is difficult to discuss the technical questions normally our subject. From hour to hour, as the screaming headlines of a puerile press meet our anxious eyes while we remain in ignorance of the real facts of the critical struggle, we realize to what insignificance the ordinary happenings of daily life are reduced. Even the exciting experience of our earthquake with its resultant conflagration, just twelve years ago, seems petty in comparison with the events that we are compelled to witness at a distance and as through a glass darkly. We are suffused with sentiments of gratitude to the brave men that are battling for our hearths and homes amid the crash of exploding shells and the reek of deadly gases; we offer hourly homage to those that are asserting their manhood against the onslaught of the hated Prussians and the peoples whom they have so easily perverted into international brigandage. To the brave British that have borne the brunt of the recent attack, to the gallant French that have come so promptly to their aid, and to our own fine boys, who at last have been permitted to take their proper place in the ranks of the defenders, to each and all we stand in respectful salute. The end is not yet. Many days of bitter fighting will ensue before the issue of this long-drawn battle is decided. More anxiety will be our portion; but let us remember what Napoleon said, when somebody deprecated the British as soldiers: "They lose every battle except the last." Let us remember how the French smashed the Prussians and the Austrians time and again when properly led by Napoleon and his marshals. And as for our own representatives, we need no reminder, although history is eloquent enough; we know them, that suffices, and in that knowledge we rest secure that neither over them, nor through them, can the Hun and his cohorts go. They shall not pass! We abide the event in quiet confidence that, whether today or tomorrow, now or next year, the German tide of militarism will shatter itself against the walls of freedom and at last the world shall emerge from this nightmare of horror, this "sword and fire, red ruin, and the breaking up of laws."

The Liberty Loan

In our last issue we printed sixteen pages advertising the third Liberty Loan, this space having been given by seventeen different manufacturers for this patriotic purpose. Public interest in the present issue of bonds to the amount of $3,000,000,000 is splendidly keen, and we anticipate a proper response. The issue should be easily over-subscribed, of course, for the people of the United States have both the money and the will to loan it to the Government for the furtherance of this righteous and decisive war. After all, those of us that subscribe for a gilt-edged security at a good rate of interest are not doing anything remarkably self-sacrificing, are we? Contrast such an advantageous business transaction with the incomparably greater hazard that is being taken by our gallant soldiers and sailors. Consider what the British people are doing at this time: calling upon their manhood up to 50 years of age to serve in the armies now locked in deadly contest with the oncoming Enemy. What is the loan of a few billion dollars as compared with the sacrifice of men of mature age, of heads of families supporting not only their own children but in most cases an aged parent or a less fortunate brother or sister of advanced age. Men of 50 have large responsibilities, they are near the close of an active career; to them actual participation in warfare means the end of everything for which they have worked and planned. Yet the older manhood of Britain is as willing to make the same supreme sacrifice as their sons who rushed to enlist in the early days of the War. We bow our heads in deep respect to these gallant men, and we feel deeply that the secure investment of our savings for the common cause is a small thing to do and one therefore that can only gain comparative dignity by being done promptly and cheerfully. The President has spoken for us, we have accepted the challenge of Germany, realizing to the full her fell purpose, which was exhibited with cynical brutality only recently in Russia—as if to remind those that had become callous to the sufferings of Belgium, of Servia, of Poland, and of France, what is in store for them if the Prussian heel treads farther across the earth. Our resolve, says the President, "shall appear in the utter sacrifice and self-forgetfulness with which we shall give all that we love and all that we have to redeem the world and make it fit for free men like ourselves to live in." . . . "There is, therefore, but one response from us: force, force to the utmost, force without stint or limit, the righteous and triumphant force which shall make right the law of the world and cast every selfish dominion down in the dust." Those that cannot contribute to that force by fighting personally on the battlefield must aid in the other ways left to them. The least we can do is the best that we can do. Do it now.

Control of Mineral Production

Metal miners and smelters seem to be unduly alarmed over the emergency bill that provides for "encouraging the production, conserving the supply and controlling the distribution of those ores, metals, and minerals that have formerly been imported, or of which there is or may be an inadequate supply." As originally drawn the measure included iron, copper, lead, zinc, and other common metals, but it is now restricted to antimony, arsenic, chromium, graphite, magnesite, manganese, mercury, molybdenum, platinum, pyrite, tungsten, tin, sulphur, and alloys and chemicals derived from them. It would have been wise at the beginning of our organization for war to have appointed an independent committee to coordinate the mineral industry, but this was not done. Division of responsibility for the supply of any class of

material hampers efficient correlation of the work of production and distribution. Nowhere has this been more conspicuous than in mobilizing the chemical industries. There is talk even yet of gathering these under the control of a single committee, but confusion and delay would follow such a change. The final result might be advantageous, but the loss of effectiveness during the period of transition would diminish the value of such a belated reform. The sulphuric acid business has been considerably muddled by apportionment among various departments and committees. Almost every industry is dependent in some manner upon sulphuric acid; the Department of Agriculture is vitally concerned in the use of it for making fertilizers; the War Department is equally solicitous over the manufacture of explosives, into which sulphuric acid enters. It is easy to surmise what difficulties, delays, and conflict of interests would follow from placing the administration of this chemical under a new organization, unfamiliar with the arrangements previously made for production and distribution. It would halt preparation in a thousand directions, disastrous to the best interests of the Nation, but gratifying to sympathizers with the Enemy. The same argument applies to the sudden consolidation of the mineral industry under a so-called dictator at this time. The idea was rejected promptly by the committees on mining both in the Senate and in the House, which was the reason for limiting the bill to such materials as mainly and normally come to us from abroad. If there be any fear lest an attempt be made to widen its application, on account of the broad language in which the purpose of the measure is stated, its scope can be more narrowly defined by amendment. There is no doubt of the utility of doing what the bill proposes. The Committee on Mineral Imports and Exports, through its chairman, Mr. J. E. Spurr, has declared that the main problems to be solved are those of labor and transportation. We possess the resources, but these must be developed in the places and to the degree that the output can be made available where most needed. It would be foolish, for example, to increase the production of Californian pyrite and undertake to ship it across the continent when the Appalachian resources, near the Eastern centres of acid manufacture, can be made to yield more abundantly. On the other hand, the shortage of manganese and chrome ore necessitates intensive development of Western deposits, and the means of transportation must be arranged. The last example illustrates the wisdom of another provision of the bill whereby the administrator of these essentials is permitted to enter into contracts for two years, and even to advance funds for plant and equipment. The sum of $50,000,000 is provided for such encouragement of these special industries. Many of them would not be undertaken without aid of this kind, because the unfavorable conditions of price and transportation that prevented their development before the War would crush them after the War. The object sought is precisely that of encouraging enterprises at present largely non-existent, but apparently capable of supplying our needs in the present crisis. In many instances a large amount of initial exploratory mining must be done to open the mineral deposits for production; expensive equipment will be needed, roads are to be built, and quarters for operatives to be erected. The preliminary outlay must be covered by guaranty of a market at fair prices long enough to return the capital with profit. High prices alone are not sufficient. This is not commerce, it is war! The object is to provide insurance against having to shutdown steel works for want of manganese; insurance against starving the land for want of fertilizer, so that we shall not confront famine; insurance against shortage of ferro-alloys so that the capacity of our factories shall not be lessened for lack of high-speed tool-steel, nor the life and efficiency of our guns reduced for want of resistant linings. Other features of the measure appear equally necessary. The President is authorized to make such regulations as may be essential, not only to promote production, but to prevent waste, deterioration, hoarding, monopoly, or discrimination. He may require licensing of manufacture, storage, mining, and distribution of the substances mentioned, and he is given power to fix prices. He may also requisition and assume control of any idle deposit, mine, smelter, or plant "to develop, or cause the same to be developed or operated in such manner and through such agency as he may direct." The bill is comprehensive in its provisions for securing the rights of owners in the proceeds of the development of their properties, and in prescribing penalties for practices that might affect injuriously the output and proper distribution of the commodities listed. Here we may suggest that the more immediate method of encouraging the production of sundry essential minerals is to fix a price for them, or for the metals derived from them, for a definite period, say, two years, so as to justify the outlay of time, energy, and money required to find the mineral deposit and bring it into fruitful development. The loan of money to prospectors and small operators—a large-scale grubstaking—might be another way of stimulating production, but we consider it likely that the stabilizing of prices would suffice for the purpose in hand. As to the control of these necessary operations, it would be a mistake to create a metals dictator at one stroke, but that is not contemplated. The President may delegate his authority to any department, bureau, committee, or other agency, in his discretion. The opinion prevails in Washington that the functions of the War Industries Board might be enlarged by assuming the responsibility. This proposal has much in its favor. The Board already controls several branches of the metal industry; it is organized and ready to proceed; it is an independent committee, having large freedom of action and initiative, in this respect resembling a department of the Government. It is conceivable that the administration of the mineral industry, now divided between various functionaries, might be assembled under the direction of this single organization. In this way consolidation could be effected without violent disturbance of existing arrangements, and it would contribute rationally and logically to the greatly desired end of establishing a Department of Mines, with a Cabinet officer.



Buying Combinations in the Metal-Market

The Editor:

Sir—In your issue of January 19, 1918, in an article under the above heading I note you have included the name of Goldsbrough Mort & Co., Ltd., in the German buying combination.

This is quite incorrect. Goldsbrough Mort & Co. have never had the slightest connection, or association, with *any* German metal-buying combination, nor have they ever been connected, directly or indirectly, with *any* metal business, their business being entirely that of wool, grain, and skin, brokers, and bankers.

I shall be glad if you will make the correction in your next issue.

Goldsbrough Mort & Co., Ltd.
per A. Lingrove, Secretary.

Melbourne, Australia, February 26.

[We accept the correction. The chart to which reference is made was a facsimile of the one published by the U. S. Federal Trade Commission.—EDITOR.]

Native Tungsten

The Editor:

Sir—I wish to call to your attention the discovery of native metallic tungsten on the Prefensia claim near Albion, Idaho. This might be of interest to mining men, especially those working tungsten properties. The specimen submitted to me for analysis weighed two pounds three ounces, of which over one-half was metallic. The capping was on a base of tungstite, which gradually ran into the wolframite series. The average of three analyses gave the following composition: tungsten 98.7%, iron 1.2, chromium 0.3, with traces of nickel, cobalt, copper, and manganese. This is to my knowledge the first specimen of any size of native metallic tungsten.

R. FRANKLIN HEATH.

Spokane, March 30.

[It would be of great interest to have this occurrence confirmed by samples taken by competent and well-known observers. Mr. Heath's accuracy as an analyst we do not question; but he does not assume responsibility for the specimen analyzed. It would be most unlikely that tungsten would meet conditions near the surface favoring reduction. It is apparently a magmatic emanation in oxide or sulphide form. The existence of chromium, nickel, and cobalt, essentially derivatives from a basic magma, in association with the tungsten, equally characteristic of acidic rocks, throws further doubt upon the specimen as a natural product.—EDITOR.]

Nickel-Copper Steel

The Editor:

Sir—I have noticed with a great deal of interest the recent references in your magazine bearing upon nickel-copper and copper steel, that is, steel containing a small amount, say, about 2% of copper, or nickel and copper combined.

Just recently I have been interested in watching the progress of a practical test—something beyond mere laboratory experiment along this line. This test has up to the present time produced 'assay-prills' weighing some 80 tons, and I now have before me, in a paper read before the Canadian Mining Institute at its last meeting, the data bearing upon the qualities of the product. This Nicu (Ni-Cu) steel, which I had an opportunity of watching through the process, from crude calcined nickel-copper ores, was produced not only from the raw ore, but from waste slags rejected by the nickel-copper producers of the Sudbury district, in Ontario.

As one who has developed a principle based on an older idea in metallurgical machinery, I am very much interested in the fact that some of these citations, recently made, go back many years. It was the knowledge of these old but abandoned tests that caused me to be decidedly sceptical as to the possibility of practically producing the nickel-copper-steel on a commercial basis. The early experimenters along any line are often a deterrent to advancement rather than an aid, for we are likely to conclude, as was my first impression in this particular instance, that the process must have been tried and turned down on account of impracticability. An inventor, such as Mr. Colvocoresses, has a great deal to overcome in giving reasons for previous failures or, if not failures, to explain the cause why certain processes were not before adopted. The answer is simple: either the capital was lacking or the inventor's genius was handicapped by his lack of faith in his invention, which was therefore temporarily lost to the world. In the present instance Mr. Colvocoresses backed up his invention by personal investment in his own idea, and should he make the success that I now predict for his process there will no doubt arise a swarm of claimants for priority of ideas. It is very much easier to say "I told you so" than to produce practical results.

It is the man who not only thinks invention but prac-

tices invention and accomplishes practical results, going beyond the mere formula of a thought, that the world needs. It is not only the thought of munitions but the munitions themselves that we need to win the war of advancement. There are plagiarists and infringers galore, but even these, if practical, are better than impractical thinkers who by only giving voice to their thought become obstructionists.

H. W. HARDINGE.

New York, March 30.

Professional Peonage

The Editor:

Sir—I often wonder, when I see the more or less relevant and irrelevant discussions in the technical journals in regard to the status of the engineer, whether the public in general knows or cares to know the injustice and unprofessional attitude that the employer assumes and maintains toward us. To say the least, we are the most intensively trained and the lowest paid of all the practical branches of human activity. I note that recently there is raised the question of the propriety of the men leaving an office, or employment in general, without first securing the permission of his employer. I do not feel that when a man can better himself that this system of unilateral ethics should interfere.

Permit me to submit for the information of those who do not know it that there is a 'gentlemen's' agreement that the employers are the ones who are to say whether a man shall have the opportunity to better his condition or not. I can sustain my contention that there is a collusion of many of the larger copper producers (and, mind you, it antedates the War and the present abnormal conditions) whereby no one in the employ of one will be entertained for a position in another without the present employer's consent.

Now, the injustice of this procedure is manifest, for it not only tends to discourage men so inclined from entering the profession, but it does more: it creates dissatisfaction in a force of men, and a profound contempt for such a shortsighted policy of arrogated authority. One of the companies under fire for accepting men from others without the prescribed permit (and it is respectfully submitted that we are or should be allowed both to employ and to be employed where our best interests direct) has been on both sides of the fence, depending on its particular interest on each occasion. It has taken men from others and it has complained when others have reciprocated.

Four and a half years ago a company wanted an engineer. I applied because the office in which I was employed had a most unbearable chief-engineer. I was turned down and the reason openly assigned by my prospective employer was this aforementioned gentlemen's agreement. There was no mincing of words, this was stated outright. A stranger to them was telegraphed for from another State. I immediately resigned my position and left the community, for I had fully made up my mind not to remain, and of this fact I unavailingly acquainted the one whose employ I desired to enter. The same condition exists here.

One of my brother engineers has a large family. Not long ago he was offered a position at $100 per month increase by a company in another camp. Reference was made to his present employer and he refused to let him go or raise his salary. He said that he did not want to break in a new man. Here we have a well-paid foreigner who prevents an American citizen from securing a position that will enable him properly to educate his family. I have others in mind but the above will corroborate my general statement. I feel that in the interest of enlightment and fair dealing the above should be given to the reading public, for as surely as the sun rises in the east the lines are drawing closer and closer about us as professional peons. It is this kind of craven conduct that creates mutual contempt between employer and employee, arouses suspicion between man and man, fills the land with I. W. W.'s, and will eventually bring before us the situation of "divided we fall" because we have repudiated the doctrine of "united we stand."

AN ENGINEER.

Los Angeles, March 25.

Silver

The Editor:

Sir—The article on silver by Governor Boyle and Mr. Symmes appearing in your issue of March 23 may naturally be expected to attract a great amount of attention, considering the prominence of the authors. It seems a pity, however, that they should have fallen into error in a number of instances, especially with regard to a chronology of the facts set out. They state that last September when the New York quotation for silver was $1.08½ (not $1.09½) Great Britain placed an embargo on shipments of silver into and out of India. As a matter of fact, a British order prohibiting the importation of silver and gold into India, except for Government purposes, was promulgated in the previous July, and at that time it was a general belief in well-informed circles that the action was prompted by the fact that during the previous weeks England had received far below its normal imports of the metal. Estimates place the actual imports into England during that period as not over 200,000 ounces.

The article gives the impression of an extremely narrow viewpoint and the contention that Great Britain is placing restrictions on silver because of a desire to increase the purchasing power of a pound sterling in the East. As an accusation it scarcely bears analysis. A profit of $51,000,000, which the Indian mint has made on seigniorage, is surely an insignificant item in the trade between India and Great Britain. Unless I am very much mistaken, the profit made by the Indian mint does not benefit the British treasury in any manner whatsoever. If the price of silver rises the increased purchasing power of the Orient that necessarily follows would seem to be of much greater benefit in British trade with

the Orient than is possible from any other consideration. It is Great Britain that furnishes the ships to handle the Oriental trade and the more prosperous the East is the greater the benefit of the mother country.

C. S. Herzig.

New York, March 29.

Increasing the Production of Oil in California

The Editor:

Sir—It is surprising to note that the impression is being, and has been, conveyed throughout California that all of the possible oilfields of this State are known and are at the present time either fully or partly developed. It is even more regrettable that the notion should exist that all future production must come from present known fields or extensions of them.

Being aware that it has been the American pioneer spirit that has found and proved new fields in the past, and being slightly acquainted with some of the geological conditions in untested areas throughout this State, I venture to express an optimistic view.

When O. D. Barton first went into the Lost Hills to prospect for oil he operated with a small rig capable of drilling only to a shallow depth. This he used in the face of adverse comment and the knowledge that the best previous technical calculations had determined a depth beyond reach of his drill (U. S. G. S. Bull. No. 406 p. 207) for the only oil-sand then considered as having a prospective value. There was genuine surprise in California when his well, at 527 ft., proved a good producer. The facts of the discovery were that he had used his own judgment regarding the interpretation of the oil indications in the immediate vicinity, he had faced all the hardships connected with getting such a venture under way, and he was rewarded by discovering favorable conditions for the occurrence of oil that had not been surmised before in that locality. Whether or not he previously realized all the phases of his venture is not known to me; nevertheless, the desired production was obtained, and the example here set may illustrate in a way the mistake made by discouraging wild-cat prospects too hastily.

Oil was found in the Lost Hills as an accumulation in overlying porous beds near the line of an unconformity (Bulletin 69, California State Mining Bureau). This relation exists in other fields south of the Lost Hills as far as Sunset and possibly is limited only by the extent of the San Joaquin valley and certain formations that exist through at least the south half of that depression. This possibility has been recognized, but it has not, as yet, been thoroughly tested. It, therefore, forms the starting point for some important future discoveries throughout a large area around the rim of the valley and in other parts of California. Until it has been investigated thoroughly both from a geologic standpoint and with the drill there is much room for new and important discoveries.

The development of the Santa Maria and Lompoc oilfields has proved that oil can accumulate in the cracked flints and shales of the Monterey shale series. Just how productive some of the best wells in this shale have been is indicated by the fact that one well that came in at 8000 bbl. per day in 1904 was making at the rate of over 200 bbl. per day in 1915; moreover another well developed in the same series of beds came in at 1675 bbl. in 1906 and is still producing freely. The shale and its associated beds, which give rise to this oil and form a reservoir for its accumulation, are widespread and frequently thick, throughout large portions of this State from Point Arena in Mendocino county to near the Mexican border. Wherever found oil indications are manifest somewhere in the immediate neighborhood. While some of these shale areas have been tested in a desultory manner they have by no means been thoroughly investigated or prospected, largely because of the difficulty in drilling the hard flint beds associated with them, partly because of poor financing, and partly because of past over-production of cheap oil. Until these shale areas have been investigated and tested, there is still room for other important oil discoveries as at Santa Maria and at Lompoc.

Deep drilling in the main Santa Maria oilfield has developed the fact that beneath the productive cracked flint and shale beds lies some true sand (the Vaqueros sand) that is productive. This oil-sand has considerable extent throughout portions of Santa Barbara county and adjacent areas. It has not, as yet, been systematically investigated. At the outcrops the sand shows unmistakable indications of oil at many places.

In northern California is a wide extent of beds deposited during Cretaceous time. In places these beds have developed seepages of a paraffine oil. The geological horizon of these seepages is somewhat similar to that of certain oil-horizons in Wyoming. Work of a preliminary and cursory character has been attempted, as yet without success. To my knowledge, however, the entire Cretaceous region of northern California has not been studied thoroughly. Until it has been so studied and tested no one has the right to denounce the area. From what has been observed in a preliminary way it appears that some of these Cretaceous districts invite further investigation.

There has been much wild-catting throughout the State since the first attempts to produce oil. Where success has followed large fields have been developed; where unsuccessful the territory has generally been condemned. Before rejecting any previously tested area it has been found good practice to get a history of the developments and to ascertain, if possible, any reason other than the lack of oil for abandonment. It is possible that several prospective fields have been given an unwarranted 'black eye'. For example, I had occasion to investigate one prospective field where there had been some previous drilling. I found that the field had been condemned by wells drilled at various times, none of which produce commercial oil. Closer observation disclosed that every well had been drilled near the outcrops of the oil-sand

and that the only logical place for testing the district was an anticline involving the oil-sand and situated but a short distance away. This field has so far been entirely neglected.

Again, before denouncing the future possibilities of Californian fields by noting the decline in production in 1916, the present draft on the stock of oil and the small amount of new territory brought in during the last two years, it is well to inquire into the reasons for the present conditions other than the withdrawal of Government lands and the setting aside of naval reserves in the Buena Vista and Elk hills. These facts have a most important relation to the failure to bring in much new territory during that period.

With the tremendous over-production of petroleum in California from 1910 to 1916 and in the mid-continental oilfields in 1914-1915, stocks of crude oil mounted continuously until there was 59,777,789 bbl. in storage in California in May 1915. For this over-production wild-cat wells were largely responsible. With a continued surplus production, prices ebbed and the operators found themselves on the edge of ruin. The situation was alarming, and to prevent disaster they adopted several remedies. All new drilling was discouraged, many producing wells were shut-down, new markets were sought, and all wild-catting discouraged. The results have been as desired. Over-production has been stopped, prices have been increased, stocks have been decreased, and the minimum of new fields is being brought in, resulting withal to the prosperity of the producers, just as was directly planned by them before our entrance into the War.

Now, however, the War is making new demands and the reverse of these protective measures is desired. More oil is needed, a surplus in stocks is necessary, and it becomes a duty to increase production. This is an adjustment requiring time. Fortunately the operators' seven years of past difficulties have developed the best that there is in them and confidence is felt that they will meet the requirements. Just how they are commencing is indicated in a measure by the increase in production in 1917, over 1916, from 91,976,019 to 97,781,574 bbl., by the more careful conservation of oil, and by the bringing in of the one new field at Montebello.

Since this article has to do with wild-catting, the new development of the Montebello oilfield is one of the best object-lessons in favor of that particular and necessary branch of the industry as a method of making up the necessary shortage. With stocks previously being depleted at the rate of 30,091 bbl. per day during 1917, this new field alone has produced enough to offset that draught at the rate of 10,000 bbl. per day in January and 12,000 bbl. per day in February 1918, and gives reason for a more optimistic belief in future possibilities. When it is further remembered that all past production from all wells has been made possible only through wild-catting, the vital importance of this enterprise can be the better appreciated. It illustrates the high value of courageous initiative.

It is fortunate that large areas of prospective oil-lands are owned by deed, patent, or grant, and are available for acquisition and testing. The circumstance is also fortunate that all of the Government holdings have not been classified as prospective mineral lands and withdrawn from entry. Idleness on the part of all operators is, therefore, not necessary, for want of prospective territory during the period that the legal and legislative snarls relating to naval reserves, lands withdrawn from entry, and Government receiverships are being untangled and re-snarled again in Washington. In spite of all these difficulties there is much to be done in wild-catting new territory.

In this necessary branch of the industry, if prices can be maintained and the production absorbed, there is certainly much to be done in California in stimulating the operators. Although somewhat out of practice because of the inaction primarily due to the long continued low prices, there is surely enough of the pioneer spirit left among our operators to attack the problems at hand, using at the same time all of the available knowledge and experience gained through forced economies during the last few years. Montebello is a beginning, but other similar fields must be found. If but one in four or five new wild-cat areas prove productive, the record will not be poor, particularly when it is remembered that the high gas-pressure with the accompanying flush production of a new field acts as an offset to the failure in other areas tested. An honest failure in this branch should always call for praise as a worthy and patriotic effort and not for ridicule as is too often the case, for it takes grit to face the necessary risks, and in carrying on such enterprises the operator is doing a war-time service. If successful, his pecuniary reward more than offsets his troubles.

There is every reason to place the utmost confidence in the type of man that has so far survived the hardships of the Californian oil industry. Through his past hardships he has developed into an individual who can meet any oilfield difficulty and intelligently, energetically, and successfully solve it. When all operators strive for an object something usually happens in the oilfields. The small operator has proved himself a particularly active and successful worker in prospective territory in the past. Wild-catting is a branch of the industry where he has really done brilliant work. With the larger companies now giving more attention to this vital necessity, the small operator also becoming interested, and in view of the large amount of prospective territory to be tested, there is abundant reason to believe that in addition to the new Montebello field other new fields will be brought in to increase the desired oil-supply and incidentally to demonstrate the true latent oil possibilities of this State as the clearest possible refutation of the pessimistic idea that all of the oilfields of California have been discovered.

WALTER STALDER.

San Francisco, April 2.

ELECTRICALLY smelted pig-iron is being produced at Porjus, Sweden, at the rate of 20,000 tons per annum. This plant yielded over 10,000 tons in 1917.

Geographic Suggestions of the Somme Battlefield

By BAILEY WILLIS

Look at the map of the battlefields of the Somme. In 1916 the British fought from July to November to drive the Germans from the ridge that extends from Combles to Thiepval. The area they won in four months fighting is the shaded area on the map herewith. No one can disparage the fight they put up, nor the German resistance. The British won because they were better men, better equipped, better generalled.

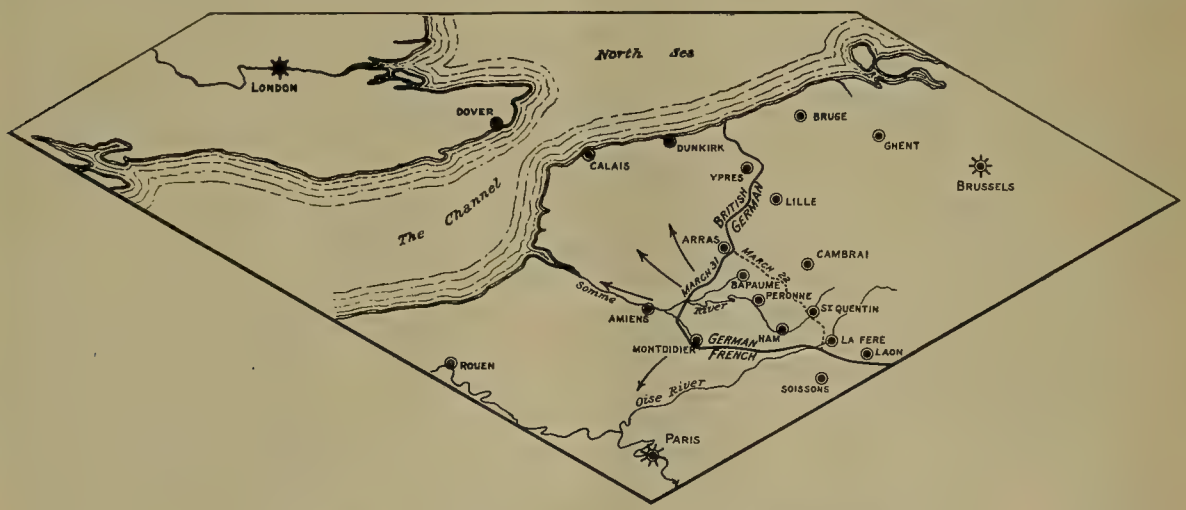
In 1918, fifteen months later, the Germans drove the British and French from the greatly larger area between the widely separated positions of March 22 and March 31. In ten days they accomplished, apparently, far more than did the British in four months, including the conquest of the heights that cost the British so dearly in 1916.

Are we to conclude that the Allies have weakened or the Germans become superior? There is nothing to support the suggestion except the bare fact of the change of position. We can dismiss it, for it is not true.

May we infer that Germany is desperate, and, like the Norse berserker of old, who relied upon brute strength and ferocity, has thrown herself upon the foe with irresistible violence to crush or be crushed? There is much of the brute courage in the German masses. They fight like the berserker. But German generals do not. They have planned far ahead. Desperate they may be, but mad they are not. Rather may we say that the Allies have retreated with a purpose. The German attack was anticipated. The overpowering offensive was met with that degree of resistance which wears it out, but does not wear out the opponents. The retiring Allies sacrificed territory, towns, battalions, guns, so far as was necessary to accomplish their pre-arranged plan. Then the retirement stopped. The counter-stroke is due.

The man on the street feels that he is watching expert players in a game of chess, in which checkmate means death to nations—and they move mysteriously, planning far ahead to achieve victory through what seems to be a desperate gambit. What is the next move?

In war, as in chess, the players manoeuvre for positions and the lay of the ground may decide the issue. The withdrawal of the Allies is apparently such a ma-



BIRD'S-EYE VIEW LOOKING TOWARD LONDON AND THE NORTH SEA

noeuvre, and it is worth while to study the ground better to understand the aim of the players in this fearful game of the People against the last of the Empires.

The board is the once checkered landscape of northern France, a plain and hill land, formerly of fields and orchards, now a desolate waste thrice swept by armies in retreat. Roads, bridges, houses, and towns have been blown up, and the very ground is pitted with shell-holes beyond number. Hell is not more desolate nor more agonized.

Two rivers, the Somme and the Oise, seven miles apart, flow parallel from the German line into the battlefield and there separate. The Oise runs straight on south-west toward Paris; the Somme winds in a great inverted S, north-west to Amiens and beyond. At Amiens the Somme is joined by the Arve, flowing north-west, and a little east of Amiens it receives from the north-east the "bloody" Ancre, which rises near

Bapaume. The flat river-valleys are swamps, passable by constructed roads, but otherwise difficult to cross with vehicles of any weight. Their general level is about 200 ft. above the sea.

The uplands also are flat, but extensive. They are low plateaus and the valleys are branching trenches sunk in them. Let us, for instance, fix our attention for the moment on Bapaume, the railway and highway centre that the English took from the Germans and surrendered to them in retreating before this last offensive. The town lies on a broad plain, with a general elevation of 450 ft. above sea-level. Near it rise four little streams, which flow north and north-east and are part of the headwaters of the Escault or Scheldt, one of the principal rivers of Belgium. They are the Exuette, Agache, the Sensée, and the Cojeul. Just east of Arras these streams are connected by canals with the Scarpe in a plain whose general elevation is about 275 ft. above sea-level. From this plain, just north of Arras, rises the lonely height of Vimy ridge. The plain is that which has been described as the plain of Flanders, and the valleys lie engraved in the slope that rises toward Bapaume.

Just south of Bapaume are the springs that are the source of the Ancre. Their waters flow west and south, encircling higher ground, and soon sink into the deep trench across which the British drove the Germans in the battle of the Ancre, and behind which they have now taken their final stand in defence of Arras and Amiens. The heights enclosed by the Ancre were the scene of the battles of July, August, and September 1916. With them are associated the struggles for the possession of Combles, Ginchy, Contalmaison, Pozieres, and Thiepval ridge. The general elevation of these ridges is but a little more than 500 ft. They form a low crest, extending from south-east to north-west across the triangular plateau that is bounded on the west by the trench of the Ancre and on the south by the wider trench of the Somme.

Another point to which our geography may well be linked is Peronne, the town that lies at the crossing of the Somme with the highway from Cambrai to Roye and thence to Paris. At this point the river turns from north to west. It thus forms a great salient toward the German lines. In its course from the south and on toward the west it flows in broad marshes, crossed only at long intervals by the highways which once existed but now exist no more. Aud thus Peronne and the bridge behind it constitute a vital point in the retreat of an army forced back upon that town.

The country south-west of Peronne, lying in the arc west and south of the Somme and bounded on the west by the Arve, is in general a flat plain, with few slight elevations and comparatively little feature for defence. It is now wholly occupied by the Germans.

St. Quentin is a point on the Hindenburg line, the name of which is familiar to every reader of the newspapers. Like Amiens and Peronne, it lies on the Somme. The three cities are nearly in a straight line; Amiens on the west, Peronne in the middle, and St. Quentin on the east. Between them the Somme makes the great double bend, first to the south and then to the north, that has been likened to an inverted S. This bend has already played its part in the issue of battles, and may play a still more important part in the fighting that is to come.

Let us now turn farther south to La Fere and Noyon. Both are towns on the river Oise, which flows south of west from La Fere through Chauny to Noyon, and then turns south-west toward Paris. The river-valley is again broad and flat, and is traversed not only by the meandering river, but by canals. The water-courses in themselves constitute an important line of defence, but in addition, the valley lies under the slopes of a plateau, which extends to the south and south-east, with an elevation of 500 to 700 ft. above sea. This plateau forms an escarpment that soon dies out toward the west, but is an important feature from La Fere to Rheims. It is the height that has been held by the French since the great German retreat of 1914. In the present attack the Germans have avoided it and have swung around its northern corner at La Fere.

Northern France is a land of chalk similar to the cliffs of England, and above the chalk are hillocks of sandstone. We have seen that there are two plains, the lower plain of the valleys, carved into the chalk, and the upper plain, which lies near the top of the chalk at its contact with the sandstone. The hillocks rise above the latter, as in the case of Vimy ridge and of the heights won by the English in the battles of 1916, between Combles and Thiepval.

The strata lie nearly flat. The chalk is not pure, but contains more or less clay and is interbedded with clayey layers. The sandstone also contains more or less lime. Under the wet climate of the region the lime is dissolved out of the sandstone, leaving an open warm soil, favorable to trees, while the same process of solution in the clayey chalk layers yields a sticky clay soil. The valley plains and uplands are surfaced with clayey mud. Hard stone suitable for road-building is entirely wanting, and the soil itself does not contain enough sand to form with the clay a compact embankment. The engineer may imagine what a task it is to maintain a roadway for army transport during heavy rains such as now are reported.

The entrenched character of the ravines and valleys is due in large part to the material in which they are cut. Where a stream has sunk down through a chalky layer, and come upon a bed of impervious clay, its valley widens faster than it deepens. The chalk, attacked along its lower edge, breaks off in steep faces and gives an abrupt rise from the valley-floor to a height of five or even thirty or forty feet or more. The profile then curves gently back to the surface of the plateau. Such a trench is invisible from a distance. The eye sweeps the landscape of a seemingly continuous plain, neither light nor color suggesting the sunken ground that must be crossed in an advance against the enemy. The chalk cliffs readily lend themselves to the excavation of natural and artificial caverns. In medieval times extensive catacombs were dug in them, and recently luxurious dug-outs or em-



THE SOMME BATTLEFIELD, SHOWING THE GERMAN ADVANCE, MARCH 22 TO 31, 1918

(Pozieres, mentioned in the text, lies south-east of Thiepval and a little nearer to Albert)

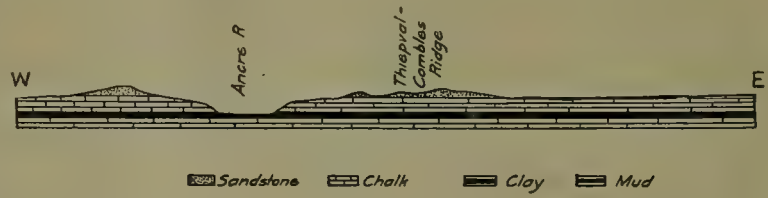
placements for machine-guns have been excavated by the indefatigable Germans. The accidents of battle and of victory and the lines of final defence of the world against the German empire are determined by the deposits laid down beneath the ancient seas that spread the clay and chalk and sand, which are now the once fair land of northern France.

With this background of the battlefield in mind we may turn to consider the struggle of the ten days of the German advance. We may be sure that every attack has been made according to a preconceived plan, based upon a full knowledge of the character of the terrain and the opposing forces; and we may be equally sure that the resistance offered by the French and British has been proportioned to the force of the blow and the requirements of retreat with the least possible loss. The element of ignorance or surprise may be regarded as eliminated in this struggle between veteran strategists on the long contested battlefield.

The German attack was first reported as being directed against the British lines south-west and west of Cambrai. Shortly afterward we heard of fighting between St. Quentin and La Fere and of the German advance toward Ham. In the northern part of the field the severest fighting developed north-west of Bapaume, around the head of the Ancre valley. In the centre the attack was pressed against Peronne, and in the south an effort was made to cross the Somme in the vicinity of Ham and to advance to Nesle. Plainly the immediate object for which the different operations were scheduled was to drive the British into two positions from which retreat would be difficult, and to outflank the obstacles behind those two positions. In the north the triangular area isolated by the marshes of the Somme and the valley of the Ancre formed one pocket. In the south the great bend of the Somme between St. Quentin and Peronne formed another. In each case the marshy river-valleys offered obstacles to retreat, and the capture of Peronne split the retiring forces in the centre while seizing the principal crossing. It was, no doubt, defended with a tenacity that deprived the enemy of much of the expected fruits of his strategy, but it is probably a safe inference that the guns and prisoners lost were taken because of the natural difficulties opposed to retreat.

The position in which the British have elected to stand in the northern part of the field is entrenched by the valley of the Ancre. They did not attempt to hold the high ground south-west of Bapaume, from which in 1916 they forced the Germans only after four months fighting. They did not pause until they had placed between them and the enemy the deep trench that can be crossed only at enormous sacrifice. An advance farther north, in the vicinity of Arras, will be far less costly for either one of the opponents, and it is there, from Ayette to Fampoux, that we now hear of repeated German attacks and stubborn British defence.

In the southern part of the field the French held firm along the Oise and its canals, from La Fere to Noyon. The line to which they fell back farther west lies along low hills that extend to Lassigny south-west of a little tributary of the Oise, and thence toward Montdidier along the line of the Lassigny-Montdidier railway. The Germans took and hold Montdidier, a station on one of the railroads connecting Amiens and Paris, but elsewhere they have not been able effectively to cross the little river Arve, which runs north-west to the Somme and, like the Ancre, offers a strong defensive position. It protects the Allies as far as Moreuil. At that point, however, their front turns north by east, and stretches across the angle between the Arve and the Somme, about 12 miles south-east of Amiens. Here we may expect the heaviest German attack, for it is the least defensible part of the Allied line and nearest to Amiens. Any advance here is sure, nevertheless, to cost the Germans very dearly, for, if the Allies retire farther, they will place themselves behind the Somme and the Arve and have the Germans in a narrow corner commanded by the heights beyond the rivers. And, even so, the Germans would not have reached Amiens, which lies farther down the Somme beyond the junction of the streams.



IDEAL SECTION ACROSS THE ANCRE TRENCH AND THE THIEPVAL-COMBLES RIDGE

If the geographic conditions of the present situation have a preponderating value, we might infer that the Allies would seek to lead as many Germans as possible into the area south of the Somme; to allow them to accumulate there large supplies and many guns; to weaken them as much as possible; and then to cut them off by advances northward from La Fere and eastward toward Cambrai and Peronne. Such a manoeuvre would apply to the Germans their favorite play of the pincers.

Let the French and Americans advance northward from Noyons and La Fere toward Ham and St. Quentin. Let the British advance past Croisilles and Bapaume on Cambrai. And the Germans, if they save their army at all, must lose the larger part of it. So it looks to the man on the street.*

These geographic suggestions of the immediate battlefield are not favorable to the Germans. In sweeping into the region south of the Somme they have violated a military precept, in so far as they have left behind them an area across which it will be difficult to retreat. Ob-

*In the fighting of April 7-8, the Germans attacked the French south-east of La Fere, evidently to flank their position on the Oise and to prevent the counter blow that might be expected from this side.

viously, they estimate the chances of the necessity for a retreat as small, or they are led on by an objective that is worth the risk and that could not otherwise be obtained. Some have thought that objective is Paris, but to win Paris will defeat neither France nor Britain. Others suggest that the Allied line was here weakest, and that the general purpose is merely to break through, to separate the French and British, and bring about more open fighting. But a larger objective may well be attributed to the German high command. To separate the French and British, to take Amiens—these are but initial steps in the larger program. From Amiens the valley of the Somme offers a broad highway to the sea, which is distant but 35 miles in a straight line. The Germans have advanced 37 miles, and if now they can break through the British defence they may confidently hope to fight their way to the coast. The British army would then be shut up in a low corner of northern France, surrounded on the east and south by Germans, on the north and west by the Channel. Thus isolated they might be driven from the continent, and the invasion of England might become possible, even in spite of the British navy.

If this suggestion that England is Germany's objective seems far-fetched, impossible, we need to change our estimate of the purpose that dominates the Junker spirit. *Weltmacht oder Untergang* (world empire or destruction) is no idle boast, and thus far it has been made good throughout eastern Europe. No graver error could be made than to under-estimate the purpose, the audacity, the intelligence, or the power of the Enemy. We must match it and over-match it, individually and unitedly, confidently backing Foch, Haig, and Pershing, and the men behind them.

Chromite Deposits in Alaska

Deposits of chromite have been known in Alaska for a number of years, but they became of economic interest only in 1917, with the result that ore is commercially mined at one property. The chromite deposits of present economic interest, according to U. S. Geological Survey, are at the south-west end of Kenai peninsula, in two areas, one along the north shore of Port Chatham and the other at Red mountain, about 16 miles to the north-east. Both deposits are in altered peridotite, and, so far as known, these are the only bodies of peridotite in this vicinity. Exploration farther from the coast, in the mountains, may reveal others. Peridotite of the same kind also occurs in large and small masses at several other places in the area between the Yukon and Tanana rivers, and at Livengood, in which area is a deposit of chromite.

The chromite of south-western Kenai peninsula is in lens-shaped masses that range in thickness from a few inches to 20 ft. and that lie in attitudes from horizontal to vertical. None of the lenses appears to be more than 150 ft. long. The ore is not uniform. Some of it averages 50% chromic oxide, and some is a mixture of chromite and peridotite, the leanest part of which may yield only 5 to 10% of chromic oxide. The deposit now being mined is on a spit at the south-east end of a peninsula known as Claim point, which projects south-eastward into Port Chatham. This peninsula measures about 4000 ft. from east to west and about 2200 ft. from north to south, and is joined to the mainland by a neck of land about 200 ft. wide. The rock is entirely peridotite. The known area covers about three-fifths of a square mile. The orebody is almost completely covered by water at high tide, so that mining must be done between low and half tide. The deposit is in a vertically placed lens, which has a length of about 100 ft. and a maximum width of 20 ft. About 800 tons of ore containing from 46 to 49% chromic oxide was mined in 1917, and about as much more remains in sight above half tide. Ultimately it will be necessary to work from a shaft or cofferdam.

Other lenses of high-grade ore, none more than three feet thick, occur in this vicinity, as well as a number of bodies of low-grade ore ranging in thickness from 5 to 20 ft. and varying in their content of chromic oxide from 5 to 15%. At one place on the north side of Claim point, near the crest of the peninsula, are four lodes that stand nearly vertical. These four bodies should produce, when concentrated, about 3000 tons of 50% ore. There should be available at Claim point at least 15,000 tons of chromite ore of a grade containing 50% of chromic oxide.

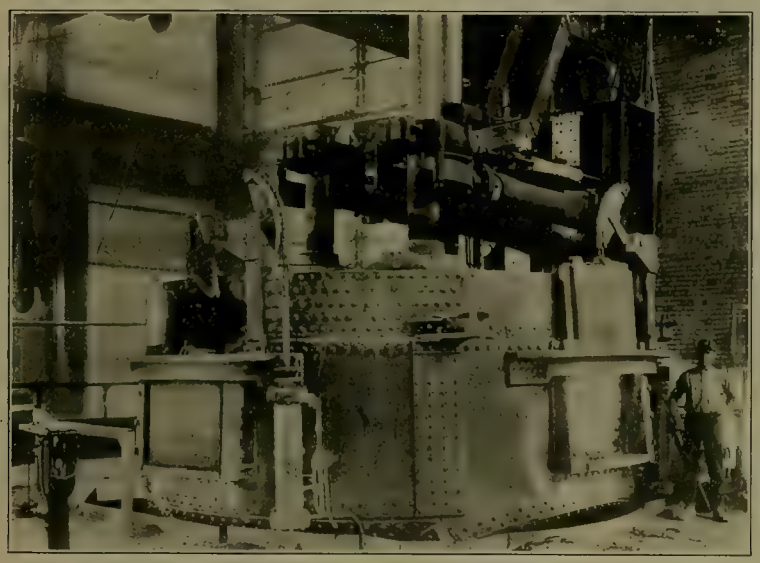
The peridotite at Red mountain is much larger than that at Claim point but is more difficult of access. The peridotite covers about three square miles and contains many stringers and lenses of chromite ore. The largest deposit observed was a lenticular body of high-grade ore not more than 75 ft. long, with a maximum thickness of eight feet at the centre containing about 1000 tons. There are many other smaller deposits and perhaps some as large or larger, all of which should yield at least as much chrome ore and possibly several times as much as the body at Claim point. These deposits are at an elevation of about 3000 ft. and at a minimum distance of six miles from tidewater. In winter the ore might be sledded to tidewater.

FUSED SILVER SULPHIDE, (Ag_2S), is sufficiently malleable at room temperatures to be rolled into strips, and at 200° C. it may be drawn into wires. According to George W. Vinal, a cold rolled strip has a large negative temperature coefficient of resistance, which is attributed to its possessing electrolytic conduction in addition to metallic conduction. A wire drawn at 200° C. is a metallic conductor only. The passage of an alternating current through a strip causes its resistance to increase, and a direct current causes a decrease. Hot drawn wires show no such effects. The a.c. and d.c. volt-ampere characteristics of strips resemble those of a pyro-electric conductor. Hot drawn wires behave as metallic conductors toward the direct current, the specific resistance at 2° C. being 17,300 microhm centimetres.

OF THE copper production of Peru, 96% is contributed by the Backus & Johnson and Cerro de Pasco mines.

Largest Electric Steel Furnace

The largest electric furnace in the world for making steel has now been successfully operating about one year at Pittsburgh. The illustration shows its general appearance. It was originally built to hold 20 tons at a charge, but it regularly makes 25 tons, and has produced as high as 30 tons at a time. It is the Heroult type of furnace, so called from the French designer. In the United States and Canada it has met with more success than any other form of electric steel furnace. There are now over 150 of them either operating or under contract in this country and in Canada. This particular furnace is in the Duquesne plant of the Carnegie Steel Co., and is the only one of its size now running. There are, however, three more in process of being erected at Gary, Indiana, which will be operating soon. Six heats are made every 24 hours in this furnace, and the charge is hot metal from large basic open-hearth furnaces nearby. The steel that it yields is of the highest quality, and is used principally for small gun-forgings required by the U. S. government. Two other furnaces similar to this are now operating at the plant at the Illinois Steel Co., South Chicago, Illinois, and a third is being installed. With its two 15-ton furnaces, this is the largest elestric steel plant in the world.



ELECTRIC STEEL-FURNACE

A METAL that will not shrink when it cools is desirable for making into patterns to use in place of wood: A completely non-shrinkable pattern-metal is unknown, but some alloys shrink less than others and one that is noted for this quality, and which is used largely for making white-metal patterns, is composed of zinc and tin in equal parts.

The Carolina Tin Deposits

The presence of cassiterite, oxide of tin, in North and South Carolina, at many places in the Kings Mountain and Lincolnton quadrangles, at one place near Gaffney, in the Gaffney quadrangle, and at one locality in the Gastonia quadrangle, has led to many attempts at mining. At the Ross mine, near Gaffney, placer mining was temporarily done at considerable profit. Practically all the work on cassiterite-bearing veins has been done at a loss, but this work has not been sufficiently conclusive to prove or disprove the value of some of the deposits. The cassiterite deposits have been found in a belt extending from a point two miles north-east of Grover, about parallel with the general trend of the rock formations, through the town of Kings Mountain, and north-eastward to Beaverdam creek, six miles from Lincolnton. The tin deposits occur in pegmatite masses within Archean rocks, either the Roan gneiss, or the Carolina gneiss along or near its contact with the Roan gneiss. The rocks enclosing the pegmatite are hornblende schist, hornblende gneiss, diorite, mica schist, and mica gneiss, with or without accessory garnet and kyanite. These formations have steep dips along the tin belt. The pegmatite occurs in sheets and lens-shaped bodies cutting the gneisses and schists. Some of the pegmatite masses are conformable with the structure of the enclosing schists, but others cut across the schist layers with various dips and strikes. The masses range from less than an inch to 100 feet wide and from a few inches to probably more than half a mile in length.

SECONDARY ENRICHMENT, in distinct zones, of lead, zinc, and silver, is noted by Fred. A. Hale Jr. in the Yellow Pine mining district, Clark county, Nevada. The zinc minerals, being more soluble, migrated farthest, while the lead accumulated nearer the surface. The silver content of the ore shows a marked increase with depth for a distance of 120 ft., from which point it decreases to its minimum at 700 feet.

LICENSES are now required for export shipments of wire-rope. This applies to iron and steel wire-rope, cable, and strands consisting of six or more wires, whether or not the wires are painted, galvanized, or coated in any way. Improper classification of material in order that it may be exported without a license subjects the exporter to severe penalties.

Sacramento Hill Disseminated Copper Deposit—I

By COURTENAY DE KALB

INTRODUCTION. The world at large has not yet been impressed with the significance of the name of Sacramento hill. Utah Copper, the first great 'porphyry' mine, the one that established a new system of exploitation and that opened the way to the profitable treatment of 1.2% copper ore, is a name known to every miner in America and to millions who are not miners; 'Nevada Con.', 'Ray', 'Chino', 'Miami', 'Inspiration', are familiar because they have been prominent as bases for independent financing and stock speculation, and also because they were brought forward in the bright aurora when the wonder of monstrous new mines of low-grade copper still made a lively appeal to the imagination. Men are growing used to them now, and the development of millions of tons of 1.70% copper ore in a rugged hill of hard brownish-red nondescript rock produces no sensation. Sacramento hill has been quietly investigated for about nine years by the Copper Queen Consolidated Mining Co., now merged into the Phelps Dodge Corporation. The more active work, however, has been confined to the last four years, after it had become apparent that a valuable orebody actually lay within reach. Even if there were no Copper Queen mine as a wealthy neighbor to Sacramento hill the orebody now disclosed would afford ample warrant for a great independent operation, yet it is almost certain that no economic geologist would have ventured to recommend the exploration of this unpromising pile of rock except for the evidence of neglected possibilities in the great granite-porphyry stock that had accumulated through years of mining upon the orebodies in close proximity. It is too late now for visitors to study the rugged cap-rock; it has all been blasted and scattered, and will soon be no more than a waste-dump in a distant canyon. Those who have kept in touch with the Copper Queen for the last 20 years, however, will remember the peculiar knotted mass of hard brown rock standing prominently in the wide arroyo, in the position of the proscenium of a Greek theatre with reference to the shafts of the Czar, Holbrook, Spray, Irish Mag, Sacramento, Oliver, Hoatson, and Junction mines, gathered in a wide



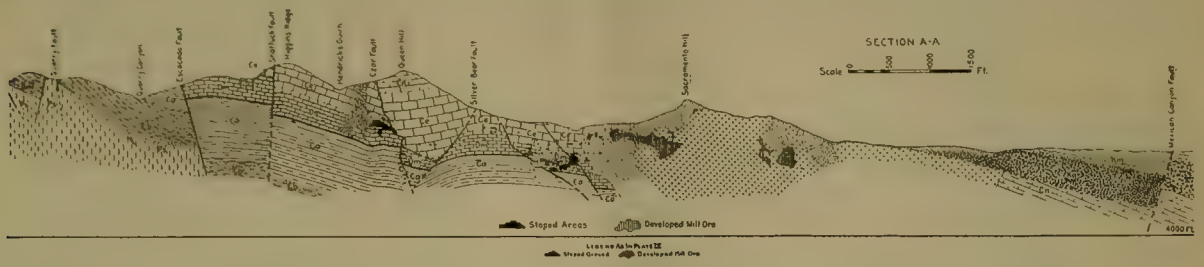
SACRAMENTO HILL, BISBEE, ARIZONA; LIMITS OF OREBODY FLAGGED ON SURFACE

are round about it. The interest at that time was fixed upon this assembled group of giants; now something has happened in the centre of the stage.

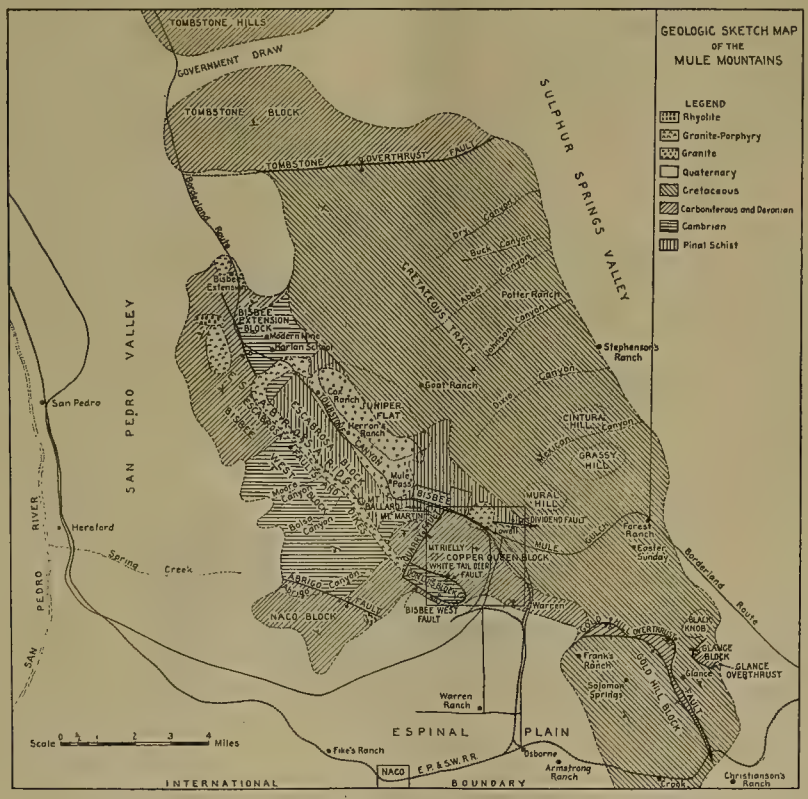
In one of the accompanying illustrations, taken from the Gardner shaft, Sacramento hill is shown almost as it stood at the beginning, except that it is scarred by roadways over which the drilling machines have been dragged, and that it shows the dump of a prospect-shaft. It is also flagged to reveal at a glance the projection of the developed low-grade orebody in outline upon the surface. The Dividend fault passes just beyond the rough mass of the hill, and on the other side of it is a range of mountains against the sky-line composed of disturbed and faulted beds of Cretaceous age. The line of sight is toward the north-east, and the Dividend fault strikes north-west. Thus the illustration affords a broadside view of the chief line of structural weakness in the district. The photographs fail to bring out the detail of the peculiarly irregular character of the cap-rock, but it is recognizable as indicative of something different from an intrusive igneous rock or a lava-flow; on close view it proves to be fragmental, and composed of many distinct kinds of rock, somewhat agglomerated, highly altered, decomposed, varying in color from gray to bright brownish-red, considerably glazed with the 'desert-varnish', and having a few areas of no great size, on protected faces and in crevices, painted a dull green with copper carbonate. Any old prospector in Arizona knows a dozen places that look more attractive. A good many that were far more brilliant have been tested and found wanting; some of them may have been 'turned down' after a too faint-hearted exploration. The first efforts to ascertain what might lie hidden in Sacramento hill would have exhausted the resources of the average development company without yielding definite encouragement, as will be noted in the sequel.

When one looks over the busy Warren district with its numerous shafts and sees the train-loads of ore hurrying to the smelters at Douglas it is hard to realize the struggles and doubts and fears of the early days, or the narrow chances by which these mines were once saved from abandonment. The Queen company and the Atlanta company, working side by side, had exhausted all the ore in sight, and extensive exploration had failed to lead to new discoveries. Dr. James Douglas had originally taken an option on the Atlanta for $25,000, but failed to finance it; finally he was called upon, in 1881, by Mr. James, of Phelps, Dodge & Co., to report upon this identical claim, which later had been offered to that firm. Dr. Douglas reported upon the progress of work on the Queen as well as the Atlanta, both of which were then producing. Sinking on the Atlanta had extended to a depth of 100 ft.; the orebody was near the boundary line of the claim and would probably enter the Queen claim if it held out, and there was no ore of any value on the surface of the Atlanta. The uncertainties, including the danger of legal complications in case the orebody should enter the Queen ground, led him to advise his client that "the risks were too great to be taken by a purchaser who was not able and prepared to lose all that he had invested." It was decided to take the chance, and an adit was driven parallel with the side-line of the Queen, but it proved to be too low to strike the Queen orebody, and too high to intersect the Atlanta. Dr. Douglas records also that he "sank on one of the small bunches of ore that cropped out on the east side of the claim. It twisted in and out in descending, but apparently led to nothing of consequence, and was abandoned. Had it been followed 200 ft. it would have led us into the big orebody two years in advance of its actual discovery." Both the Queen and the Atlanta passed through vicissitudes, the heavier burdens falling upon the Atlanta, which was owned by Phelps, Dodge & Co. Its only asset, after several years of work, was a sum of $4000 paid by Mr. Simsbury of transcontinental stage-coach fame for permission to mine lead carbonate ores on the Atlanta claim to be shipped to his smelter at Benson. Dr. Douglas, in his own story of the mine, writes: "The spring of 1884 was a critical period in the history of Bisbee. The big orebody on which the Copper Queen had been working since 1880 had pinched out clean before the incline sunk on it had reached the fourth level. The Queen had run a drift west into the King, and was drifting east along our side-line in search for another orebody. Mr. Williams was opposed to the opinion of a San Francisco attorney whom Mr. Martin (of Martin & Ballard) had sent down to advise whether the law of the apex applied, and who had advised him that under the Richmond-Eureka decision the limestones between the porphyry contact and the outcrop on the top of the Queen hill might be considered a vein or lead under the law, being a mineralized zone. The Queen also had employed Mr. Price, of San Francisco, to advise them as an expert, and he pronounced only 90 days' ore in sight, and could not tell them where to look for more. Results have since proved that there was not more than 90 days' ore in sight. Meanwhile Mr. James and Mr. Dodge had become thoroughly disheartened, having spent some $80,000 and over two years on exploration that had not yielded a carload of ore. There was a meeting with me in New York. The only underground trail I could recommend as worth following was a narrow vein of ore crossing our line from the big Queen orebody. Mr. Williams considered that he had no right to follow it. We could reach it only by sinking from the surface and drifting, and to do so would cost, I estimated, $15,000. So the last $15,000 to be dropped into the mine was, with much misgiving, put at my disposal, and John Prout and I selected the site where the shaft was to be sunk. * * * The foot of the Queen incline, which coincided with the bottom of the original Queen orebody, had nearly reached the side-line of the claim, and therefore a drift easterly along the side-line in hard limestone was the exploratory work undertaken by the Queen—a long drift having been previously run to the West without encountering any ore. Meanwhile our Atlanta company was sinking its shaft in barren limestone a little to the

south of the point toward which the Queen drift was directed. Thus, final pieces of exploratory work were under way, prior to the abandonment of their property by both companies, when, almost at the same time, each of them struck a new orebody, which appeared to be dipping north-west, or in a direction the reverse of that of the body originally discovered. The two companies then presently give way to sulphide. As Dr. Douglas wrote, in some reminiscences of Arizona mining in 1909,* "We all imagined, in our shortsightedness, that the day of doom for the copper interests of southern Arizona would date from the transition from oxidized to sulphide ore. It was not until all the richer carbonate ores had been wasted by being largely converted into slags that the companies



CROSS-SECTION THROUGH ORE DEPOSITS AT BISBEE, INCLUDING SACRAMENTO HILL



GEOLOGICAL SKETCH-MAP OF THE WARREN DISTRICT, ARIZONA

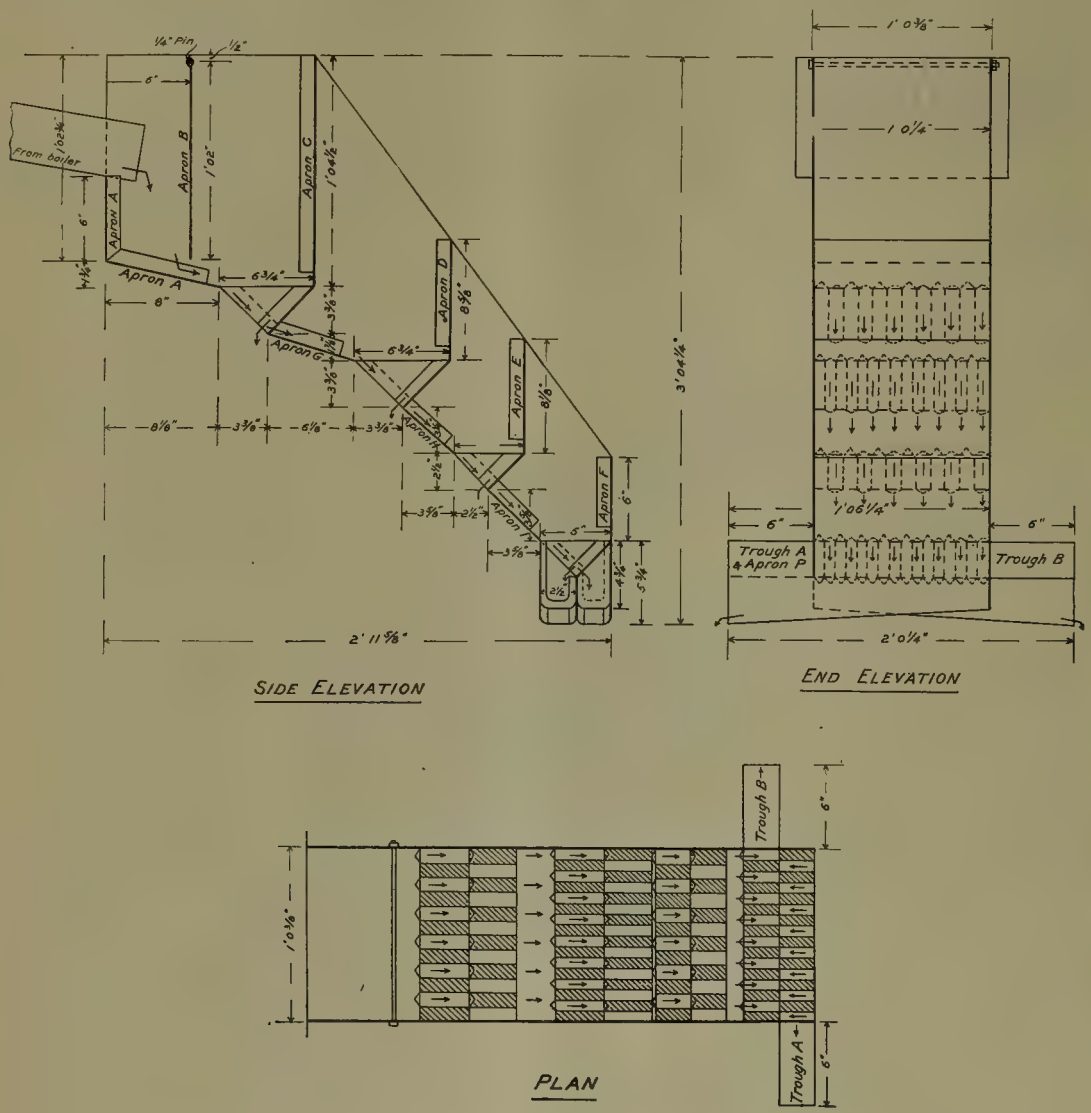
wisely decided to consolidate on equitable terms, rather than waste their funds in obtaining a legal interpretation of an even more complicated problem than that involved in the Richmond-Eureka 'apex' case."

The continued development of chamber after chamber of valuable oxidized copper ore did not, however, establish confidence for the future. The life of the mines was regarded as doubtful; it was argued, not only at Bisbee, but also at Clifton and Globe, that the oxidized ore must recognized that their salvation depended upon securing sulphide ores, upon making metallic copper through the medium of matte, and throwing away less copper in the slags." Thus the sulphides, when first beginning to appear, were regarded as a nuisance; today the Warren district produces chiefly sulphide ores, and the advance in metallurgy has made it possible to treat the low-grade

*'Conservation of Natural Resources', Trans. A. I. M. E. Vol. XL, p. 422.

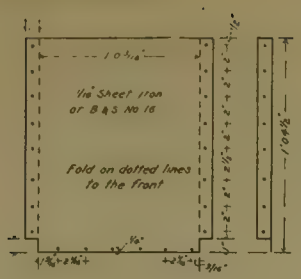
chalcocite deposits in Sacramento hill that average only 1.70% copper. This has added perhaps 20,000,000 tons to the resources of milling and smelting ore available at the Copper Queen mines, in addition to which a few million tons of ore averaging slightly lower than 1% copper may be amenable to treatment by heap-leaching, giving a return of 75 to 80% of the metal content.

superintendent, drove many hundreds of feet of drifts within the porphyry stock, but unfortunately on a horizon below that in which lay the ore. It was only when the 200-ft. level from the Holbrook was driven that commercial ore was discovered beyond the limestone contact. As disclosed later, an extension from the 200-ft. level of the Holbrook shaft, driven in a south-easterly direction

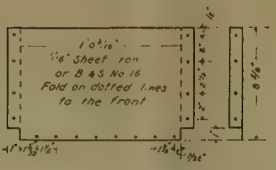


PLAN AND ELEVATION OF SAMPLE-SPLITTER

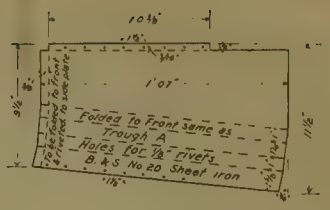
Development. The uninteresting mass of Sacramento hill lay untouched for decades after Bisbee had attained worldwide fame as a copper-producer. Nevertheless, Dr. Douglas always expressed faith in the existence of ore under this rugged pile of rock, and instructed his son, Walter Douglas, when he became superintendent of the Copper Queen in 1899, to acquire at any reasonable cost such claims as were not owned by the company in the neighborhood of Sacramento hill. Mr. Douglas, while for 150 ft., would have entered the ore-zone had the drift been prolonged 450 ft. farther, but the course was changed, bearing more to the east, and this ultimately proved to be nearly tangential to the orebody as now developed. After driving 300 ft., work was stopped in June 1908, and was not resumed until July 1909. The Sacramento adit was started from the northern flank of the hill in January 1910 and penetrated the top of the east ore-zone at a distance of 700 ft. from the portal.



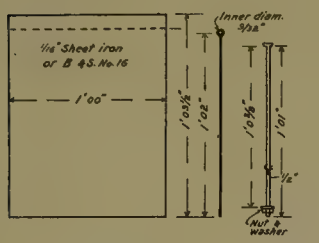
APRON C



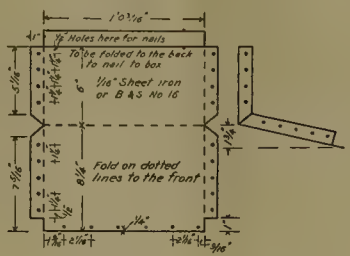
APRON D



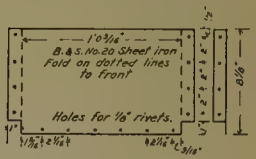
TROUGH B



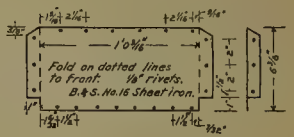
APRON B PIN for B



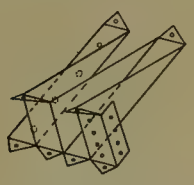
APRON A



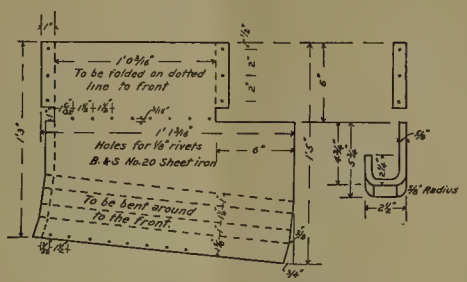
APRON E



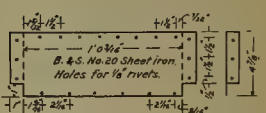
APRON G



Sketch showing METHOD OF FOLDING

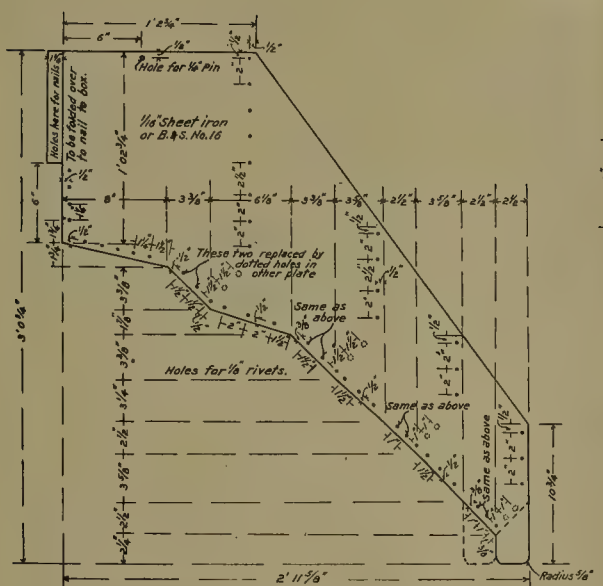


APRON F and TROUGH A



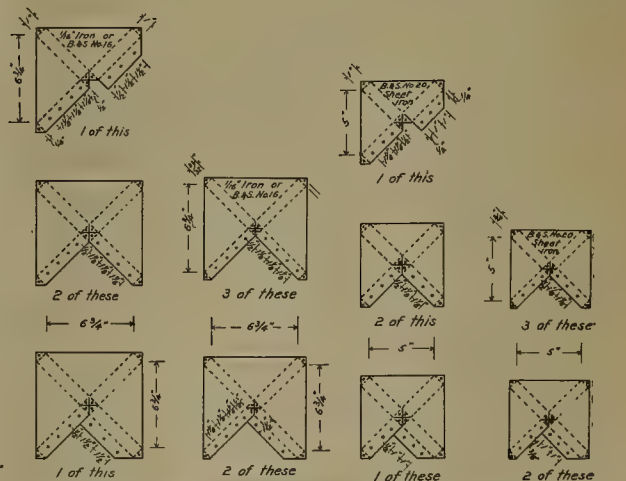
APRON H

APRON I the same, except that top and bottom rivet holes are reversed.



SIDE PLATES

One cut as shown with full lines, and one with dotted lines.



SPLITTER No 1 SPLITTER No 2 SPLITTER No 3 SPLITTER No 4

PARTS OF SPLITTERS

To be folded on dotted lines, and cut on full lines

Holes for 1/8" rivets

DETAIL OF SAMPLE-SPLITTER

The work was concluded in August of that year, and it had given encouragement for the continuance of the earlier drift. This skirted the west orebody for some distance, but without affording indications of positive value. At 1000 ft. the drift was turned sharply to the south. Ore was found within 80 ft., in July 1911. Another cross-cut, 550 ft. from the point of departure, had been turned south-westerly. This passed good ore on the way, and cut workable sulphides only after having penetrated 125 ft. beyond the ore-zone as now delimited. That point was reached in June 1911. A station was cut in the Sacramento shaft between the adit-level and the 400-ft. level, from which a drift northward traversed 210 ft. of porphyry averaging 2.21% copper. The cross-cut from the No. 277 drift, leading from the Holbrook workings, had passed through 25 ft. of material that averaged 3.8% copper. Up to February 1913 drifts, cross-cuts, and raises, aggregating 19,604 ft., had developed about 500,000 tons of ore, including a considerable tonnage averaging 3.53% copper.

Development by churn-drills was then undertaken under the general supervision of Arthur Notman, who is now assistant superintendent of the Copper Queen mines. A line of prospect-holes was first drilled to determine in a general way the extent of the orebodies. The area to be explored was roughly 3000 ft. long by 1400 ft. wide. Subsequently the larger part of the hill was tested by drill-holes at the corners of 200-ft. squares, and as the work proceeded intermediate holes were put down 100 ft. apart. Owing to the difficult topography it was not possible to space the holes evenly over the entire area, but to a large extent the ruggedness of the ground was overcome by building roads over the steeper portions almost to the summit of the hill. These roads were only 9 ft. wide, and the grades were often as much as 30%, the drills being drawn up by cables wound on the drum of the machine. The roads followed contours, as far as possible, with inclines from one level to another, and involved a total cost of $22,065, or $1.46 per foot, for the initial testing, and, as figured against 60,000 ft. of drill-holes, this item amounted to 37c. per foot of hole. In the earlier part of the campaign the cost of drilling, exclusive of the purchase price of equipment, is stated by Mr. Notman to have been $2.70 per foot, of which $1.99 was for labor and supplies, and 71c. for road-building. This figure was based on 8000 ft. of drill-hole. Drilling was done by a Star steam-machine, and by four Armstrong electric drills. Details of the performance of the steam and electric drills are given by Mr. Notman;† he concluded that electric drills could be operated at a trifle less cost than steam-drills. The odds were nearly even, however, and after the first active campaign was ended the work was continued with a heavier Star steam-drill, which is now busy on the deeper eastern extension of the orebody beyond the area already proved. Three shifts are operated, and the records show an average of about 60 ft. of hole drilled per 24 hours. In the softer ground 100 ft. per day is not uncommon, and an advance of 147 ft. in one day has been made. The holes are started with a diameter of 10 in., and usually end with a 6-in. casing, although some of the deeper holes are finished with a diameter of 4 in. The crew consists of a driller, a helper, and a sampler. The usual methods of sampling have been employed, the sludge from the bucket being run through a 'splitter', delivering $\frac{1}{16}$th to the drying-pan. Accuracy in the design of the splitter is an important factor, and the alternately wide and narrow splits in the Bisbee design are worth noting. This arrangement has been found to give more uniform results, and to break up the tendency to concentration when the pulp washes through the sampler. As the construction of such a piece of apparatus, though seemingly simple, is in reality a careful tinsmith's job, and is likely to go wrong in the hands of a workman who has never seen one before, the detailed drawing given herewith may prove useful. The split-box is made of galvanized iron, No. 16 Brown & Sharpe gauge. The dry weight of the sample taken with this apparatus in the Sacramento hill operation was about 10 lb. per foot, a 50-lb. sample representing five feet of hole. The assay cost was 3.5c. per foot, which is included in the general expense of $1.43; the initial cost of the drilling machines and other equipment, distributed to 60,000 ft. of bore, averaged 17.2c.; and the total cost came to $1.97 per foot. The checking of the drill-samples by raises, in which channel-samples were taken, has afforded remarkably accordant results. As a fair example, a raise sampled by channels cut every 5 ft., at a distance of 2½ ft. from the original drill-hole, and yielding samples averaging 8 lb. per foot, gave an average assay-value of 3.79% copper against 3.8% from the drill-samples.

The deposit consists of two parts separated by a zone of feebly mineralized ground about 400 ft. wide. The two orebodies lie in the same general direction, and a single axial line bearing N. 80° W. will cut approximately through the centre of both. Therefore they are named respectively the West and the East orebody. In the West orebody more than 7,000,000 tons of mill-ore, averaging in excess of 2% copper, has been developed, and 1,000,000 tons of +0.7% suitable for leaching in heaps. The East orebody, still in the development stage, has more than 10,000,000 tons in sight, but the average grade is considerably lower. Drill-testing is still in progress at the east end, and will be continued with one drill until the entire area has been covered, which seems to afford possibilities of a large addition to the ore-reserves.

(To be Continued)

†Trans. A. I. M. E. Vol. LII, Sept. 1915

THE SCHOOL OF MINES of Saint Etienne, in France, which had been closed after the outbreak of war, has just re-opened, with 26 students who had been retired from service on account of serious wounds, together with others between the ages of 15 and 19 years. An innovation in the history of this ancient technical institution is the admission of women to the courses leading to the degree of mining engineer.

Smelting Changes to Conserve Zinc

By WOOLSEY McA. JOHNSON

*In the retort-zinc works a charge of roasted zinc ore with a side mixture of carbonates and silicates, analyzing on the average 50% zinc, is mixed with 55% or more by weight of a mixture of coal and coke analyzing 60 to 70% fixed carbon. The ore is of varying fineness and the coal and coke are usually crushed in a semi-moist condition through a ⅜-in. screen. With ore of a slaggy nature, the proportion of coal is increased, even to an equal weight with the ore. The average charge per retort for a monthly run of a plant on ore, as distinguished from retorts on blue-powder, ladle-skimmings, and other middle products, runs from 60 to 66 lb., with a mean of 63 lb. for the South-west, with standard retorts 8½ in. diameter and 50 in. long, inside dimensions, when using roasted sulphide ores. Conditions will change these figures, but 40 lb. of ore per cubic foot of retort-space is, I believe, an average in the better-operated plants. Since the rise in the price of spelter, the tendency has been to over-charge. To remove the slag that is formed when retorts are over-charged, extra men are put on to 'gum-chisel' the retorts to prevent 'set' furnaces and 'butchered retorts'. Taking the above conditions as premises, four to six times the amount of coal is necessary for the reduction, as shown by the fact that the residues analyze as high as 35% fixed carbon. There are good reasons why this excess of fixed carbon must be used. These may be enumerated as follows:

(1) High reducing power, especially at the end of the shift, to reduce any carbon di-oxide to monoxide, and cause good condensation of the vapor. It is well known that CO_2, if formed in the retort, oxidizes the zinc-vapor at lower temperatures, and is the cause of the formation of an excessive amount of blue-powder.

(2) Heat conductivity as high as possible, so as to permit the heat, as soon as it permeates the walls of the retort, to flow to the inside of the charge in order that as uniform a temperature as possible may be attained in the retort. For this reason large pieces of coal, ore, and coke are charged, since fine material is a poor conductor of heat.

(3) Porosity; if the charge be too dense, the back pressure of the gases produced is so great that the reduction is hindered. Moreover, porosity allows secondary gaseous reduction to proceed:

(a) $ZnO + CO = Zn + CO_2$

(b) $CO_2 + C = 2CO$

(4) The charge must leave a residue that is substantially non-slagging in character. Since carbon is infusible, this can be attained by having sufficient fine carbon present in the charge, so as to leave particles of carbon in the residue.

In my work on electric smelting where only 12% of coal was added, it was shown to be possible, operating on a fairly large scale, namely, 1 ton of charge per day, to reduce zinc ore successfully with only the theoretical amount of coal. This points the way for certain improvements in the reduction of zinc ore in the retort. Coal-dust firing, used successfully in the cement and smelting industry, was taken as a pattern. In this, the almost instantaneous oxidation of carbon is attained by the use of coal in the form of dust. Since any reduction process is likewise an oxidation process, it is not fanciful to regard zinc reduction as an oxidation of the 'charge'-coal. Tests were made, grinding both the zinc ore and the coal to 80-mesh and finer. These fine mixes were worked off in a crucible or in a retort, and while they produced certain advantages, they also showed conclusively that the fine charge had the disadvantage of being so dense as to hold back the zinc-vapor and gases, and so to diminish the speed of the reaction. In the conventional furnace, large pieces of coke are put in to 'ventilate the charge.' Accordingly, an addition was made of broom-straw. These yield a corbonized skeleton that is preserved during the retorting operation and provide a path for the gases, so that they have a way of exit. Moreover, these carbonized skeletons, or eductors, are an ashless and active form of carbon, and thereby reduce the carbon di-oxide to carbon monoxide. Since the flow of the gases naturally takes to these eductors, this super-reduction is efficient in improving condensation. In these tests, the percentage of reducing material was gradually decreased from 60 to 50, 40, 30, 25, and 20%, successively. It was found that with complete reduction (residues containing 2 to 0.5% Zn) there was no slagging of the ore, provided the proportion of coal was left above 20%, unless the ore was especially slaggy. For instance, using an ore with Zn 22%, Fe 33, S 3.8, SiO_2 6.4, CaO and alkali 4%, with 20% anthracite, there was slight fritting, but none with 25% coal. In general, with reducing coal analyzing fixed carbon 67%, volatile matter 26.6, ash 12.4, and an ore analyzing Zn 43.5%, Fe 7.10, CaO 40, or more, there is no trouble in getting residues that contain absolutely no 'gum' or slag, and analyzing in zinc 2.1, 0.6, 2.9, 2.1, 1.8, and 0.5%. The ore-charge per retort was thus raised to 100 lb., and the coal reduced to 30% or lower. The reason is that the charge is highly reductive, because of its fineness and the peculiar way it is 'ventilated', and since the immense number of fine particles of carbon left at the end hold up the slag-making particles and any

*Abstract: 'Fine Grinding and Porous Briquetting of the Zinc-Charge', A. I. M. E., February meeting.

iron sulphides, little gum is formed, and, if formed, it does not touch the retort-walls. Instead of the carbon particles passing through the process without oxidation, many of them ⅛ in. diameter, and without performing any useful purpose, the surface of the particles is increased 40 to 50-fold. Holding to the original simile of coal-dust firing and remembering that in zinc reduction two solid reagents must be made to combine, the great theoretical advantage of a finely-ground porous charge is evident. For practical working, however, a charge must be a fair conductor of heat, for zinc reduction is heat-absorbing. This fineness of the charge, while it certainly promotes the reduction if properly 'ventilated', makes the charge a poor conductor of heat, which is a decided disadvantage in practical retorting. This poor conductivity is overcome by briquetting, which lessens the volume, but at an expense of $1.50 per ton of ore. Since the density of coal is less than half that of the ore, the reduction of the percentage of coal from 60 to 30 or less increases weight of zinc ore per cubic foot from 42 to 63 lb., or increases the charge per retort from 67 to 100 pounds.

Assuming a cost of $17 per ton of ore for smelting under present conditions, the fine grinding, ventilating, and briquetting permits a reduction in cost, by means of increased charging, of $5.67. The reduction in charge-coal cuts the cost of coal from $2 to $1.20. There would be a reduction in furnace labor and a reduction in retort consumption because the charge gives a residue that blows out clean. I believe that the recovery will be increased because of low residues and decreased retort-consumption; perhaps this saving will amount to $3. The credits thus total $10.97 while the debit is $1.50; or a total net saving of $9.47 is possible. Concluding, it may be stated that the present method of using a 400% excess of reducing-coal is unscientific for the reason that such an overwhelming excess is not needed. Whether the reduction be done by solid carbon or by carbon monoxide, coal that passes through the process to a large extent in large particles, not acted on at all, serves no useful purpose except to make the charge heat-conductive. Fine grinding of coal and ore, unless it be flotation concentrate, utilizes the efficiency of the coal to its maximum, and produces collateral advantages. Kernel-briquetting gives the necessary heat conductivity. The comcercialization of this proposal would, in my judgment, effect an important saving in coal, zinc, and labor, which would benefit the Nation as a practical application of sound principles of conservation.

VIRGIN SPELTER, according to the classification of the American Society for Testing Materials, consists of five grades, namely, No. 1 or high grade, No. 2 or intermediate, No. 3 or brass special, No. 4 or selected, and No. 5 or prime Western. No. 1 must not contain over 0.07% Pb, 0.03% Fe, 0.07% Cd, and must be free from Al. The sum of lead, iron, and cadmium must not exceed 0.1%. With No. 2 the maxima are raised to 0.2% Pb, 0.03% Fe, and 0.5% Cd, the sum total not exceeding 0.5%. In No. 3 the impurities may reach 0.6% Pb, 0.03% Fe, and 0.5% Cd, with a total under 1%. No. 4 may contain 0.8% Pb, 0.04% Fe, and 0.75% Cd, with a total not over 1.25%. For No. 5 the tolerance is 1.6% Pb and 0.08% Fe.

Preferred War-Time Industries

It would be impossible to arrange a list of essential industries for the conduct of the War in the order of their relative importance. Preferential treatment according to a scale of priority would soon cause a smash. The best that can be done is to separate the industries that contribute to imperative and immediate needs from those that do not so contribute. This has been done by the War Industries Board, the object being to accord the preferred list priority of service as regards transportation and fuel. The following is the official register, alphabetically arranged: Plants engaged exclusively in manufacturing aircraft or supplies and equipment, ammunition for the United States and the Allies, Army and Navy cantonments and camps, small arms, chemicals, coke, electrical equipment, electrodes, explosives, farm implements, ferro alloys, fertilizers, fire-brick, food for human consumption, food-containers, gas, gas-producing machinery, guns, hemp, jute and cotton bags, insecticides, fungicides, iron and steel (blast-furnaces and foundries), laundries, machine tools, mines, mining tools and equipment, newspapers and periodicals, oil, refineries (mineral and vegetable), oil-well equipment, public institutions and public buildings, public utilities, railways, railway equipment and supplies, refrigeration, seeds (except flower seeds), bunker coal (not including pleasure craft), ships, ship supplies and equipment, soap, steel plants and rolling-mills, tanning plants (except for patent leather), tanning extracts, tin-plate, twine (binder) and rope, wire-rope and rope wire.

MOLYBDENUM STEEL is used for the rifled liners or tubes of guns, for armor-plate, armor-piercing shells, permanent magnets, safes and bank vaults, lamp filaments, self-hardening and high-speed machine tools. Molybdenum steel, says Ernest R. Woakes, compares favorably with tungsten steel and does not require such a high temperature for hardening. Salts of molybdenum are used in pigments and for producing a yellow glaze on porcelain. The ammonium salt is largely used as a reagent for the estimation or detection of phosphorus. It is also said that a compound of molybdenum is used as a preservative for cordite when stored in hot climates. Steel-makers generally reckon that it requires two and a half times as much tungsten as it does molybdenum to produce a steel that will give approximately similar results.

AUSTRALIA will have spent, by September next, the sum of £233,000,000 ($1,118,000,000) on the War, according to the Commonwealth Treasurer. Of this £100,000,000 ($480,000,000) had been raised in Australia, the balance in England. This is equal to $96 per head. No. 3 war loan, of £40,000,000, is now being subscribed to.

REVIEW OF MINING

NEW YORK

The New War Loan.—Mexico.—American Metal Co.

The financial topic of the week has been the terms of the new War Loan. The smallness of the amount asked came as a surprise, but the terms were regarded as favorable, especially with reference to maturing. The comparative shortness of the term will do much to prevent market depreciation, such as has been evidenced with previous war issues. Liberty 4s have apparently not yet touched bottom, and their inability to respond to the fact that they would be convertible into the new issue at par is explicable by the fact that conversion would insure the new interest rate, but that the maturity feature would be retained. New York is allotted about $1,500,000,000 in the new loan. Local organization is complete and comprehensive. Much has been learned by the floating of previous loans and a general and systematic canvass is to take place. Apart from this it is realized that many of the people have been educated in thrift by the possession of a Liberty Bond and are now anxious to add to their reserves; a closer realization of the War will make others respond; and the more favorable terms, which will tend to prevent undue market depreciation during the life of the loan, will satisfy those whose circumstances make it impossible to invest in any security whatsoever without paying preliminary regard to cash value at any time when they may be obliged to realize. There is a general impression that the loan will be largely over-subscribed. In some quarters it is expected that the record—the English war loan of a year ago, amounting to $4,900,000,000—will be eclipsed. Seventeen towns and districts in New York State over-subscribed their quotas before the official date. Optimistic forecasts are to be condemned when they spring from a determination to 'let George do it.' In the present instance there is a widespread conviction that the Great Cause can be helped by active participation, and this augurs success for the new issue.

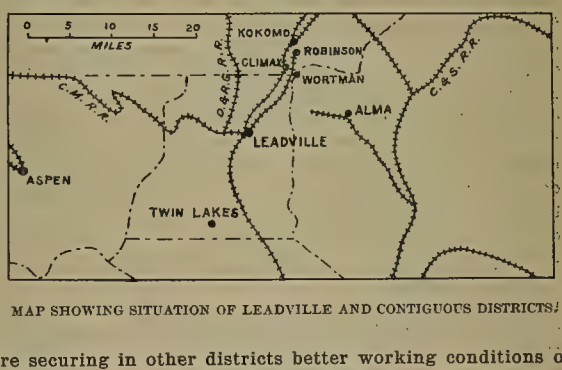
The Mexican situation is being viewed with increasing optimism. Reports of the re-opening of mines and gradual resumption of mining and milling operations are being received. Communication is improving, and letters from the South come through fairly promptly. The recent Mexican government decree exempting mining machinery from all import duty will encourage the industry, at the same time proffer a field for expansion for American mining machinery manufacturers whose export trade may have been curtailed by the recent shipping regulations. Another matter for favorable comment is that the Mexican government has seen fit to modify the decree of September last with reference to importation and exportation of precious metals. The present restrictions are drastic enough, but satisfaction is expressed that the 'thin edge of the wedge' of disapproval has been applied with success. After stating that permission for the export of bullion must in all cases be obtained from the proper authorities, the new decree ratifies the clause in the previous decree with reference to the exportation of ores and concentrates; it prohibits the exportation of gold bullion of local production, of all gold coin, and domestic silver coin; it permits the exportation of Mexican silver currency provided that an equal value of gold bullion is imported for Government minting; and it makes the importation of gold free from consular fees and other charges.

The authorities at Washington have given passports to one of the vice-presidents and the treasurer of the American Metal Co. to permit them to go to Switzerland for the ostensible purpose of arranging for the elimination of German control in the company's Mexican interests. Prior to the declaration of War this company was admittedly German, and since March 1917 it has been under surveillance by the United States authorities. In October last the Custodian of Alien Property seized some of the assets of the company.

LEADVILLE, COLORADO

Labor Shortage.—Manganese Reserves.—Gold in Sugar Loaf.—Diamond-Drilling.—Lease Notes.

Operations in this district are considerably hindered by the most acute labor shortage experienced in many years. With the beginning of trouble culminating in a strike last year, many of the best miners left the district and have not returned. Others are leaving continually, and apparently



MAP SHOWING SITUATION OF LEADVILLE AND CONTIGUOUS DISTRICTS.

are securing in other districts better working conditions or higher wages than can be obtained here. For the first time Mexican labor has entered the mines at Leadville. The Yak is the only important company that has yet accepted Mexicans, but it is possible that others will be forced to do so unless conditions improve. Mexicans have almost completely substituted the Austrians and Slavs at the Arkansas Valley plant of the A. S. & R. Co.

In a recent report of the U. S. Geological Survey, in which the manganese resources of the Western States are listed, the Leadville district is credited with having 13 deposits with possible reserves of 1,500,000 tons. The average grade is 23% Mn with 27% Fe and 12% SiO_2.

The Bohn property on Carbonate hill is credited with being the producer of the best manganese ore now being extracted in Colorado. The product now being shipped carries from 35 to 38% Mn. An immense body of the ore has been blocked out.

Gold has just been discovered for the first time in the Sugar Loaf territory through development that is being carried on at the old Bartlett mine, for many years a large producer of high-grade silver ore. A 5 to 12-in. vein was cut in one of the main silver shoots, assaying from 2 to 26

oz. gold per ton. Although the Sugar Loaf area is one of the oldest parts of the district, this discovery is the first intimation that it contained any gold ore. Extensive development has been completed through the Bartlett, Dinero, and Virginius mines, where the richest silver veins here were opened, but in all the ore extracted not a trace of gold was found. Development at the Bartlett requires constant attention from local mining men, who are eager to learn whether the discovery is just an isolated fissure or a feeder to a well defined orebody. The present extent of the gold vein has little importance in itself, but the fact that, after years of continuous operations in many properties, gold ore carrying as high as 26 oz. has been discovered, is regarded as holding great possibilities. Both the Bartlett and the Dinero are shipping a regular tonnage of rich silver ore, some of the product running 3000 oz. per ton. This production, together with the gold strike, has renewed interest in the Sugar Loaf area, and a great deal of new development is expected to start this month.

Lessees at the Sunflower shaft of the Nisi Prius in Iowa gulch have another important discovery in a large body of lead-silver ore. This was found in one of the big manganese stopes, which had been partly worked out and temporarily abandoned, and has developed into a continuous shoot 8 ft. wide and 15 ft. high. The first assays gave 15% lead and 11 oz. silver, but more recent tests show 23% lead and as high as 35 oz. silver per ton. The ore is a yellow ochre, and was exposed by the caving of a thick seam of giant clay, up to which the manganese had been extracted, leaving it as the apparent end of the ore.

The manager of the Dold Mining Co., C. J. Dold, has resumed sinking the Northern shaft and plans to continue this work until the parting quartzite has been penetrated and the second contact reached. The Northern is now 645 ft. deep, the bottom being in quartzite. Another 50 ft. is expected to put the shaft into the contact. Deeper work will be determined by conditions here. In the Coronado property adjoining the Northern, large bodies of lead-silver sulphides were encountered in the second contact, and there is every reason to believe that these ore-shoots will be found extending into the Dold ground. For several months, the Northern has been a heavy producer of manganese, and several of the largest deposits opened in the district are now being developed. The Dold company proposes to re-open the old Newell shaft, west of the Northern, for handling the manganese.

The manager of the Matchless Mining & Leasing Co., Edward Huter, has started a diamond-drill in the bottom of the Matchless No. 5 shaft. Sinking was started recently in the Matchless shaft in an effort to penetrate the parting quartzite, but it never emerged from this formation. The extremely high cost of sinking caused the management to stop, and determine possibilities by drilling.

The old Keen shaft on Yankee hill has been re-opened by Austin Blakey Sr. and J. P. Hepburn. An electric hoist is being installed, and the shaft will be re-timbered to the bottom, 335 ft. The Keen lies directly on the well-defined orebelt that traverses the northern extensions of Yankee hill, and opened in the Ponsardin and Hayden shafts. These properties are both heavy producers of lead, silver, and zinc ores.

Engineers from the Western Chemical Co. at Denver are making an examination of the Greenback property in Graham park. The work is in charge of Mr. McDaniel, well-known in Colorado. Large deposits of pyrite of high sulphur content have been opened in the Greenback, and the sale of the property to the Denver company is expected when the examination has been completed. The property is now owned by Patrick Mulrooney, and was unwatered some time ago.

VICTORIA, BRITISH COLUMBIA

Legislation Affecting Working Hours; Views of Those Interested.

A general eight-hour day for men employed in and around the metal and coal mines of British Columbia seems assured. A bill providing for such an innovation has been placed before the legislature of the Province by the Hon. Wm. Sloan, Minister of Mines, at the session now in progress. While it has not yet passed the House, indications are that it will become law at an early date.

In one of these measures the Metalliferous Mines Inspection Act is amended to read that the working day of those employed underground shall count from the time they leave the surface until their return to the surface; and that those employed on the surface at or about a metalliferous mine shall not be required to work for a longer period than eight in any twenty-four hours.

An amendment is also proposed to the Coal Mines Regulation Act giving the men employed on the surface at or about a coal mine the same working day as that given his fellow, whose work takes him underground, by the British Columbian Legislature in 1905. Ever since that year the coal miner of this Province has had the eight-hour day; that is, it has not been permitted that his employers keep him in the mine for a longer consecutive period, his working day counting from the time he left the surface and not from the time he picked up his tools at the working face.

Still another legislative proposal of similar character has been submitted by the Attorney-General. It provides for an eight-hour working day in and around smelters. Those employed within these plants, being more affected by the fumes, have had this concession. The Act under consideration would give the same to those otherwise engaged; in fact would make the rule generally applicable to all, with few exceptions, on the payrolls of smelting companies.

The Minister of Mines argues that these steps have been demanded by miners and smelter-men for years, that failure to take definite action has caused constant friction between employer and employee, and that the establishment of the principle of an eight-hour day for such industries will have a salutary effect. It is his opinion that under such a working arrangement the men will be more satisfied, and there will be less reason for industrial trouble. In this connection he points to the strikes in British Columbia in 1917: at Fernie, where the coal mines were closed for several months; at Rossland, where a lockout was declared by the Canadian Consolidated Mining & Smelting Co., when the men threatened to strike; and at the Trail smelter, where work was stopped for several months in an effort by the men to obtain an eight-hour day. These are illustrations of how industry may be interfered with and production diminished through a spirit of discontent and dissatisfaction among workers. The mineral output of British Columbia in 1916 was $42,290,462; in 1917 it dropped to $37,182,570, the difference being attributed to these disturbances. It is Mr. Sloan's hope that with the grievances settled, the present year will be free of such trouble, and mineral production of the Province will rise to the 1916 mark and, possibly, to the $50,000,000 mark.

Coal-mine operators of British Columbia are not in favor of the contemplated legislation. They have lodged their protest with the Minister of Mines. They argue that shorter hours will mean less production at a time when, because of the demands of the War, greater output is essential. They say in effect: "We do not object to the principle of this legislation, but we think it is inopportune." In discussing the matter with Mr. Sloan, they suggested that the proposed law might be deferred to six months or a year after the end of the War. In this connection reference was made to the large exports of coal from the United States to Canada

last year to meet a shortage in the Dominion, which threatened a serious industrial and domestic situation when coal was much needed in the United States. It was stated that, while this had been done once because of an unexpected emergency, it scarcely could be expected to be repeated. The Dominion Government, consequently, was expecting an output from western Canada of 2,500,000 tons more coal this year than in 1917, in order that the contemplated demand might be met without extraordinary calls being made on the United States. This was cited as proving the imperative necessity not only of maintaining, but of speeding-up production in British Columbia.

No soldier, or sailor, or member of any of the Allied forces engaged on active service in connection with the War, who holds mineral interests in British Columbia is permitted to suffer material loss because of his or her enforced absence from the country. The personal pronoun 'her' is used advisedly, as the law applies to nurses engaged with the military or naval forces. The free miner's certificate, which is the basis of the mining laws of the Province —it being necessary that it shall be renewed every year and without which no mineral right can be held, apart from a Crown Granted mineral claim—is maintained in good standing for those so occupied. They are not required to do the usual assessment work required on claims and, in the event of their death, the rights of their heirs are fully conserved. The legislation, of which this is a brief and general outline, has been re-enacted by British Columbia from year to year since 1914. At the present session of the Legislative Assembly, however, the Act was made operative for the continuance of the War and for a period of six months thereafter.

LEAD, SOUTH DAKOTA

Manganese, Molybdenite, Oil, and Spodumene Mining; Recent Developments.

Roubaix.—The Custer Peak Copper Co. has started enlargement of its main shaft to one of three compartments. The mine has been opened to a depth of 300 ft., while considerable lateral work is completed on two levels. Some new mine equipment will be added, and some changes will be made to the plant before concentration is resumed.

Custer.—Machinery for the 100-ton concentrating plant under construction by the Spokane Lead & Silver Co. has all arrived, and is being erected. It is expected to place the new plant in commission early this summer. Development of the mine continues favorable.

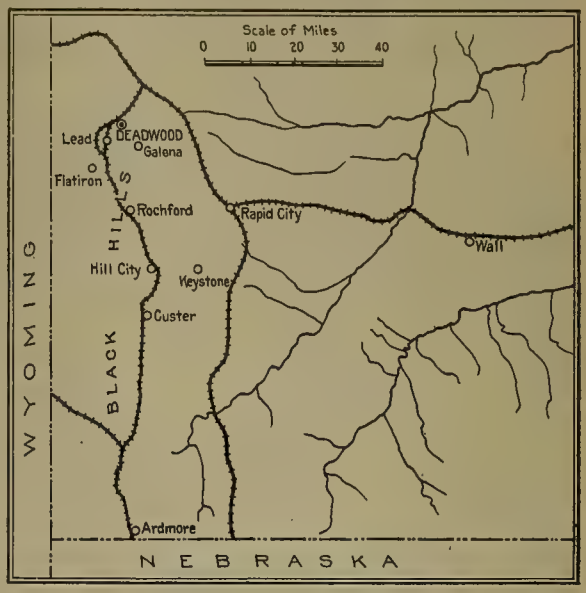
Hill City.—The Blue Lead company has started work at its copper mine. Old workings are being re-timbered and placed in shape for continuous operation. One car of dump ore shipped during the past year returned over 6% copper. Regular shipments of this material will be made.

The Dakota Continental Copper Co. is making arrangements to resume diamond-drilling. This work will be done from the lowest workings, and will be continued for several months. The Summit mine has been undergoing development by this company for the past 16 months.

Keystone.—The Rheinbold Company and the Standard Essence Co. have again commenced the shipment of lithia ores to New Jersey. Since late last fall none was sent for the reason that carload lots would not be accepted for points east of Chicago. This difficulty has been adjusted, and regular shipments will be made. Five cars are being loaded with spodumene and amblygonite.

Ardmore.—With the return of moderate weather, development of the field north of here has again commenced in earnest. The Shiloh Oil & Refining Co. continued drilling throughout the winter, and its well is nearly 2000 ft. deep. ——The Hat Creek Co. has a well down over 650 ft. and has resumed drilling after a suspension for winter.——The Wykota Oil Refining Co. has started a well and is making good progress. The bringing-in of any one of the above wells will prove the field, and indications point to the presence of oil at a depth of about 2000 feet.

Central City.—Al Fish and associates have discovered a deposit of molybdenite on their property on False Bottom



PRINCIPAL CENTRES IN THE BLACK HILLS OF SOUTH DAKOTA.

creek. Only a small amount of work has been done, but this will be continued during favorable weather. The material is found in a 'vertical', and is of a good grade.

Lead.—Since the shipment of one car of manganese from the Fremont property, development of this mineral has been started on other claims. In Strawberry gulch, James Brown has opened ore, while deposits in the vicinity are being developed. At the Kilorne property, near Rochford, manganese is being developed, and it is anticipated that several mines will be producers. At some of the properties there seems to be an excess of silica, so it is probable that a concentrating plant will be erected to dress this ore.

TONOPAH, NEVADA

Extension and West End Developments.—Divide District Railway.

The Tonopah Extension company reports that connection has been made from the 1680-ft. level of the Victor with the intermediate drift from winze No. 1501 on the Murray vein. The raise proves the persistence of the Murray vein a vertical distance of 200 feet.

A compressor has been erected at the Ohio shaft of the West End mine. This machine, with that at the West End shaft, permits of more development at the Ohio. The 800-ft. level of the West End is being driven to connect with the Ohio. An electric haulage system will be put in.

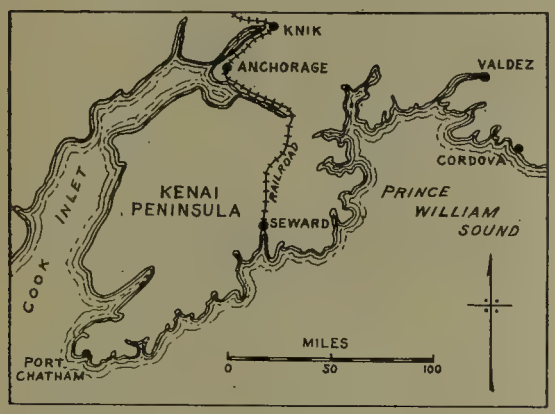
Surveyors of the Tonopah & Goldfield railroad have been making a preliminary survey from Tonopah to Gold Mountain. Another survey will be started from some point between Tonopah and Goldfield. In all probability the new district will have a spur connection with the main line in the near future.

The Silvermines Corporation at Hornsilver has experienced financial difficulties, and is in the hands of a receiver. The mill is being operated as usual.



ALASKA

Deposits of chromite have been known in Alaska for a number of years, but they became of economical interest only in 1917. The deposits of present interest, according to the U. S. Geological Survey, are at the south-west end of Kenai peninsula, in two areas, one along the north shore of Port Chatham and the other at Red Mountain, about 16 miles to the north-east. Both deposits occur in bodies of altered peridotite, and, so far as known, these are the only bodies of peridotite in this vicinity, but exploration farther



MAP SHOWING SITUATION OF CHROME DEPOSITS ON KENAI PENINSULA, ALASKA.

from the coast, in the mountains, may reveal others. Peridotite of the same kind also occurs in large and small masses at several other places in the area between Yukon and Tanana rivers, and at Livengood, in that area, there is a deposit of chromite, but the ore in the interior of Alaska could not be mined profitably except when prices are high. The deposit now being mined is on a spit at the south-east end of a peninsula known as Claim point, which projects south-eastward into Port Chatham. This peninsula measures about 4000 ft. from east to west and about 2200 ft. from north to south, and is joined to the mainland by a neck of land about 200 ft. wide. About 800 tons of ore containing from 46 to 49% of chromic oxide was mined in 1917, and about as much more remains available above half tide. Ultimately it will be necessary to work from a shaft or cofferdam and hoist ore to the surface, a method that will increase materially the cost of mining.

Juneau.—Alaska Gastineau in March treated 150,093 tons of ore assaying $1.114 per ton. Loss in residue was 20.5c. per ton. For first quarter of 1918 the following figures are available.

Month	Tons	Gross value	Tailing value	Extraction %
January	197,300	$0.903	$0.200	77.85
February	140,305	0.934	0.189	79.76
March	150,093	1.114	0.205	81.60

Kennecott.—A threatened strike on the Copper River railroad was averted by an adjustment of wages. In March the Kennecott company produced 5,772,000 lb. of copper, compared with 5,888,000 lb. in February and 5,970,000 lb. in January.

ARIZONA

Ajo.—The New Cornelia ore has improved in grade from 1.54 to 1.65% copper. An experimental flotation plant is to be erected. The company produced 3,218,000 lb. of copper in March, compared with 3,606,000 lb. in February, and 4,136,000 lb. in January.

Bisbee.—Calumet & Arizona produced 4,386,000 lb. of copper in February, against 2,900,000 and 4,748,000 lb. in the preceding two months.

Shattuck-Arizona company produced as follows in March, and for first quarter:

Month	Copper, lb.	Lead, lb.	Silver, oz.	Gold, oz.
January	849,440	84,000	9,599	106
February	854,042	66,765	6,590	73
March	1,013,593	66,878	11,429	89

The mill building is complete, awaiting machinery.

Clifton.—The Arizona Copper Co. produced 4,000,000 lb. of copper in March, against 3,600,000 lb. in February, and 2,500,000 lb. in January.

Globe.—Old Dominion produced 2,872,000 lb. of copper in March, against 2,841,000 lb. in February, and 3,400,000 lb. of January.

Metcalf.—Shannon Copper Co. produced 962,000 lb. in March, against 788,000 lb. in February and 972,000 lb. in January.

Miami.—Production of Miami Copper Co. in March was 5,174,365 lb., against 4,709,484 lb. in January. This is the highest yield since work was resumed last August.

Inspiration Consolidated produced 8,750,000 lb. of copper in March, compared with 6,200,000 lb. in March, 5,000,000 lb. in January, 5,600,000 lb. in December, and 2,500,000 lb. in November. The mill is now at full capacity.

Prescott.—The old Peck silver mines in the Bradshaw mountains are to be re-opened by C. E. Battan and others of El Paso.

ARKANSAS

Yellville.—Three important deposits of zinc ore have been found by drilling on Cowans Barrens plateau, south-east of this place. One hole cut ore from 64 to 80 ft. depth, assaying 9% blende. At 160 ft. the ore carried 12.5%, and at 260 ft., 16%. Another hole is to be drilled.

CALIFORNIA

Colfax.—A half interest in the Black Oak gold mine has been acquired by D. A. Russell and Lee Gray, and work will be resumed soon. The property, which formerly yielded rich ore, has been idle several years.

Rising Sun is said to be developing well. Deeper work is to be done. A cyanide plant is in operation. Hathaway & Martin of Nevada City are in control.

Engelmine.—The Mason Valley Mines Co. of Nevada has taken over the M. B. H. copper mine near here. Prospects are said to be good.

The Engels Copper Co. has appointed Duane Rebstock of Arizona to take charge of the safety-first department.

Kennett.—Wage differences between Mammoth Copper Co. and its mechanics have been settled by arbitration of the Federal Wage Commission. The men were allowed advances varying from 5 to 10%. While they are not all satisfied, they will abide by the ruling.

Redding.—The American Gold Dredging Co. is to increase its capital from $15,000 to $60,000. The company is assembling material to build a dredge on the Menzel ranch, recently purchased, across the river from Redding.

Winthrop.—Bully Hill mines and 15-mile railroad, owned by the General Electric Co., has been taken under option by the A. S. & R. Co., the first payment being made recently.

Yreka.—Irwin brothers, F. W. Williamson, and Roy Hollowell are developing a promising group of copper mines adjoining the Evergreen cemetery near Yreka. The first-named have made an initial shipment of chrome from their Greenhorn district property.——Papas and Bellnap have taken a lease on Morgan brothers and Herzhog mercury mine, on Empire creek.——The Mercury company of Yreka has acquired the quicksilver mines at Cinnabar spring, 30 miles west of Hilt, and will equip with modern machinery.

COLORADO

Boulder.—The Slide Gold Mining Co. at Gold Hill is successfully treating low-grade ore from the dump. Flotation is employed in the plant. The old mine is to be re-opened, the 1000-ft. shaft being unwatered at present. G. W. Teal is manager and Charles Gustafson is superintendent.

The Horsfal gold mine, recently re-opened after being shut for 30 years, is showing good ore at 400 ft. Shipments will be started soon. C. O. Oliver is in charge.

Creede.—The Collins and Wheeler lease on the Quintette property is shipping 30 tons of ore per day averaging over 100 oz. silver. The orebody, as far as developed to a depth of 100 ft., is 20 ft. wide and 80 ft. long.

Creede Exploration Co. is prospecting below the level of the Nelson adit. Drifts are being driven both ways from the Berkshire shaft on the 100-ft. level. The Commodore shaft has been unwatered to the bottom, 450 ft. below the adit-level, where a station is being cut. This company's prospecting operations at the King Solomon mine did not result satisfactorily, and work there was stopped.

Lessees are shipping from the Bachelor, Commodore, and Last Chance-Del Monte mines.

Creede United Co. is getting a little ore from the Happy Thought mine and concentrating it by occasional operation of the Humphreys mill.

The Equity mine is shipping regularly.

Cripple Creek.—Hayes and Carter, lessees on 1200-ft. level of Vindicator, have opened a new shoot 30 ft. wide, all of shipping grade. Coarse ore assays 1 oz. and screenings 4 oz. per ton.

Red Mountain.—Crawford Mining Co. has been operating in this district during the winter, and will be among the large producers this year. Shipments will probably start with opening of the railroad. The road from the Bastow mill to the Genessee mill is reported to be open. Warren Prosser, superintendent of the properties, reports conditions good and expects the tonnage to exceed greatly that of 1917. These properties were formerly under lease to J. M. Hyde, and were known as the Genessee.

Telluride.—The Lewis mine is opening new ground, while its mill has been closed down temporarily.

Molybdenite ore has been mined near Norwood and the operators are trying to get a mill to treat it.

The Tomboy has been making large shipments of iron concentrate.

The Smuggler Union has been steadily increasing its shipments.

Wagon Wheel Gap.—The fluorspar mine is shipping 2000 tons per month. Most of the product is shipped to steel mills in different parts of the country for flux, but some shipments of 98% pure fluorspar are shipped to Eastern chemical works.

IDAHO

Hailey.—The Mascot M. & M. Co., in charge of H. E. Johnson, is to drive a 3000-ft. adit to prospect its P. K. claims. Drills will be used.

Kellogg.—Nabob Consolidated has cut its Denver vein at 900 ft. depth. It is over 8 ft. wide, two feet carrying lead-zinc ore. W. A. Beaudry is manager.

Wallace.—Dividends paid by companies in the Coeur d'Alene region for first quarter of 1918 were as under:

Company	Amount
Bunker Hill & Sullivan	$490,500
Hercules	750,000
Hecla	50,000
Interstate-Callahan	232,490
Federal	209,757
Tamarack	53,287
Caledonia	234,450
Big Creek	5,000
Total	$2,025,484

A year ago the total was $2,599,940, and in last quarter of 1917, $2,018,940.

Success Mining Co. is doing much better under new management. Ore production in January and February was valued at $68,962, of which $23,915 was profit. Losses were previously made. On 1500-ft. level is a new shoot 80 ft. long so far as opened. Mill is dressing 97 tons daily, averaging 14% zinc, 4% lead, and 10 oz. silver per ton. Tailing contains 1.6% zinc and 0.14% lead. There are 80 men employed.

Rex Consolidated Mining Company has been re-organized, and is clear of debt. New capital is 5,000,000 shares of 25c. par value. Mining will be resumed at once. Main shaft is to be sunk 500 ft. below present lowest level. Upper levels and mill are to be leased.

Wardner.—Bunker Hill & Sullivan old ground above this place is being worked by about a dozen different lessees. All are reported to be mining good lead-silver ore and making profits.

KANSAS

Baxter Springs.—Royalties paid to Kansas farmers and Oklahoma Indians by lessees of zinc-lead lands during 1917 amounted to $1,257,000. Value of ore mined was $16,769,900, on which 7½% royalty was paid. Indians received $755,000 of the total. Proved mineral area is 44,000 acres, which is being extended rapidly.

Chanute Spelter Co. has 37 drills at work, and expects to add 15 more. New mills under construction will soon be finished.

Big Elk Mining Co. is to erect a 600-ton mill on its lease 4 miles south-west of this place. J. H. Mathews is president.

MICHIGAN

Houghton.—Calumet & Hecla has arranged with Minerals Separation to become a licensee under its flotation patents. The White Pine flotation plant will be ready by May 1. It is to have a daily capacity of 1000 tons, receiving material following Gates crushers, Hardinge mills, and Wilfley tables. During March there was 18,000 tons of ore concentrated at the mill. In 1917 the White Pine crushed 212,889 tons of ore, carrying 19.11 lb. per ton. Output was 4,067,529 lb. copper, at cost of 14.99c. per lb., and $2.365 per ton of ore. Profit was $397,223, after paying all charges, including

taxes. In 1916, 188,890 tons of 22.27 lb. ore yielded 4,207,449 lb. copper, at a cost of $2.082 per ton.

MISSOURI

Joplin.—Production of the Missouri-Kansas-Oklahoma region last week was 9165 tons blende and 1458 tons lead, averaging $43 and $84 per ton, respectively. Total value was $515,285, making $6,833,902 for 14 weeks. Oklahoma contributed $377,582.

The April 7 issue of 'Joplin News Herald' was a mining and industrial edition of 80 pages, covering every phase of the zinc-lead region's activities. We are abstracting freely from this issue.

Southwest Missouri Mine Safety and Sanitation Association and a local committee of 15 is to proceed to Washington to ask for a stabilizing of the zinc market. Present prices for ore are considered far too low.

MONTANA

Butte.—Anaconda produced 28,000,000 lb. of copper in March, also 5,000,000 lb. of zinc.

Butte & Superior reports as follows for first three months of 1918:

Month	Zinc in concentrate, lb.	Silver, oz.	Recovery %
January	14,300,000	265,000	94
February	12,500,000	250,000	95
March	15,000,000	285,000	94

Troy.—Snowstorm Mines Consolidated No. 1, 4, and 7 adits are being driven. No. 1 has been driven 300 ft., of which 200 ft. is in ore. No. 4 has been advanced 1300 ft. in ore. Work on No. 7 was started with two shifts on April 1. This is the lowest opening in the property. It is on the same level as the railroad, and will become the outlet for everything. Ore being delivered to the mill is the best yet. Zinc concentrates are to be sent to the Anaconda company's works.

NEVADA

Austin.—Cinnabar has been found by C. B. Smith 30 miles from rail. Several samples assay 1.7% mercury.

Copperfield.—Washoe Copper Co. is establishing a new camp 1¼ miles south-east of the Nixon-Nevada main shaft, where it will start an adit to develop the southern portion of its 720-acre property. An engine and compressor-house, blacksmith-shop, cook and bunk-houses, and a number of cottages will be built. A 10 by 10-in. Ingersoll-Rand Rogler type compressor, to drive five jack-hammers, is at Copperfield station, and a 50-hp. Western gasoline engine, as well as other machinery and tools necessary, have been ordered. R. J. Jefferson, of Reno, is managing director.

Jungo.—Oklahoma Gold Mining Co. has arranged for resumption of work early in April. A mill was erected last summer and a large quantity of gold ore blocked out. The mine is in Pine Forest range, near Quinn River crossing. Thomas Ewing is general manager.

Mill City.—A small concentrator for local antimony ore is nearing completion. There is said to be sufficient ore assured to keep the plant running for a long period. The Bloody Canyon and other mines are producing high-grade antimony ore. John Ross is manager of the plant.

National.—National Treasure Mines Co.'s property here has been examined by J. H. Weber of Salt Lake City. Adits show two zones of andesite, also belts of basalt and rhyolitic tuffs. These are intrusive and not much ore will be found in them. Most of exploration has been done at wrong points. It is suggested that a vein at mouth of long adit be prospected.

Tonopah.—The Divide (Gold Mountain) district continues to boom. By the coming fall the Tonopah & Goldfield Railroad Co. will have a line in operation.——The Gold Wedge Mining Co. was incorporated on March 30, with capital of 1,500,000 shares, 10c. par. William Forman of Tonopah is president.——The East Divide Mining Co. has been formed with a capital of $150,000 by W. E. Jenkinson, A. Dumond, and Ben Gill of Goldfield.——The Ben Hur Mining Co. was organized with capital of $100,000 by H. P. Campbell and R. J. Kelly of Tonopah.

NEW MEXICO

Kingston.—The South Percha silver mine, about 4 miles south, is yielding ore after a shut-down of 25 years. C. P. Brown, of the Empire Zinc Co., is general manager for the company which has acquired these mines.

Mogollon.—Mill building of Socorro company is making good progress. Ball-mills will be used in place of stamps. Power arrangements are to be better than in the former mill.

Oaks Co. has completed timbering its Pacific shaft. Work is under way on No. 5 level.

Tailing flume on Silver Creek is being extended to dam constructed by local companies.

OKLAHOMA

Commerce.—An oil-flotation plant is to be erected at the tailing mill of Mark Pierce and Lloyd Judd.

Picher.—Production of the region last week was 5669 tons blende and 927 tons lead, worth, including 1500 tons of blende previously unreported from St. Louis-Quapaw, a total of $377,582.

Texas Mining Co., two miles east, has nearly completed a 300-ton mill and other plant. Rich ore—20 to 30% blende—was opened at 176 ft. depth. Water is troublesome. H. H. Holeman is manager.

Keltner Mining Co. is developing rich ore and erecting a 500-ton mill. Ore is 17 ft. thick and drilling continues to prove rich zinc-lead ore.

Quapaw.—Bethlehem Zinc Co. is to erect a 300-ton mill on its lease here. H. H. Hughes is superintendent.

OREGON

Baker.—Ben Harrison gold mine, under option to E. H. Dewey of Nampa and others, has been returned to the company. About $50,000 was spent during the option.

Gold Hill.—Rainier Mercury Co. of Seattle has been organized in Jackson county, with T. H. Ellis, president and general manager, and headquarters at Beagle, Oregon. This new corporation takes over the Utah Quicksilver Co.'s 35 claims in the Meadows district, 12 miles north of Gold Hill, also the Samuel Bertleson group adjoining. These properties are contiguous to the Chisholm group, which have been producers since 1878, and are now operated with a 12-pipe furnace to reduce the ore mined during development, and pending the arrival of a 200-ton plant to be selected.

TEXAS

Austin.—Nitrate deposits are said to have been discovered in Presidio county, near the Rio Grande, and up to April 1 there had been granted claims covering 3840 acres.

El Paso.—The new No. 4 reverberatory furnace at the El Paso furnace was blown-in on April 6. This furnace is designed for fettle-feeding, using mostly Chino concentrate, with admixture of silicious ores. It is 130 ft. long and 30 ft. wide, with the usual up-cast flue to Stirling boilers for recovery of waste heat. The blowing-in of the furnace gave promise of most favorable conditions for rapid smelting, the first skimming taking place 30 hours after dropping the first charge, which is quick work for a large furnace. The copper-smelting department of the El Paso smelter is in charge of Alan F. McCormick.

Grand Saline.—The Grand Siline Salt Co. is erecting

three large brick buildings here, in which will be installed vacuum-pans, pumps, etc., for refining salt by the vacuum-tank method.

UTAH

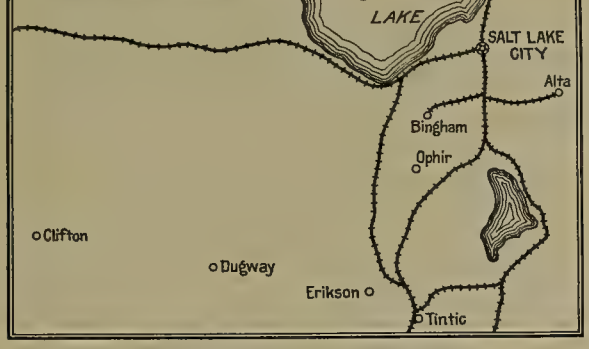
Alta.—New railroad into this district is expected to be ready for carrying ore by May 1. It will have a daily capacity of 200 to 300 tons. Little Cottonwood Transportation Co. controls the line, in charge of H. A. Dunn.

Michigan-Utah Consolidated Mines Co. reports as follows for 1917, compared with previous years:

	1917	1916	1915
Ore, tons	12,014	6,991	3,319
Gold, ounces	227	154	67
Silver, ounces	148,318	90,812	43,136
Copper, pounds	384,906	364,685	99,066
Lead, pounds	1,865,379	716,851	515,296
Net receipts	$244,125	$130,342	$29,901

Property consists of 66 claims, two being acquired in 1917. Considerable work was done from the Copper Prince adit, now in 2097 ft. A large body of ore assaying 0.025 oz. gold, 1.84% copper, 7.8% sulphur, and 52.2% iron has been developed.

Dugway.—A 100-ton smelter is to be erected in this district by the Dugway Smelting Co., work to be started in 60



MAP SHOWING SITUATION OF DUGWAY, UTAH.

days. The plant will be 47 miles from Faust, the nearest rail point. Copper ore will be supplied by a number of properties. Company has a capital of $20,000, shares 1 cent par. A. L. Thomas Jr. is president and manager and Otto Stallman, consulting engineer. Company's prospectus says that ore-reserves in the Dugway Bertha mine are 90,000 tons, in addition to which the Lucky Star, Dugway Copper, Dugway Mining, Copper Bell, Continental Mining, Lundine Bros., and other properties in the district are developing a large tonnage for the smelter. While the first unit will be of 100 tons daily capacity, power will be installed sufficient to operate a 250-ton stack. The Dugway Smelting Co. is contracting with the mines to smelt the ore on a basis of $12 per ton, with the usual bonuses and penalties, and the tests made by Messrs. Stallman and Peugeot show that the total cost of smelting this ore in a 100-ton stack cannot exceed $5.25 per ton, and this will be reduced as the capacity is increased. The Dugway ores are ideal for smelting, practically carrying their own flux. This will give the Dugway Smelting Co. a profit in excess of $1000 per day, and with increased capacity the profits will be more than proportionately larger. As a rule, the public is not cognizant of the large profits in smelting, as the returns are so large and sure that the public has never been given a chance to invest, all the capital being furnished by close corporations. A general metallurgical analysis of the copper ore of the Dugway district proportioned to the tonnage, is as follows: moisture, 5.2%; silica, 24.1%; iron oxide, 29.9%; copper, 4.9%; sulphur, 18.7%; alumina, 9.2%; lime, 7%; magnesia, 2%; silver, 6 oz.; and gold, 0.7 oz. per ton.

Green River.—Nickel is said to have been identified in pyrrhotite in the Henry mountains by H. A. Hatch. Samples analyzed at Denver showed 6% nickel.

Milford.—In the Yellow Pine mine, 10 miles south of here, a winze below the 100-ft. level shows good ore, and a carload averaging 12 to 17% copper and 10 oz. silver has been shipped to smelters. William Eyre is part owner.

Development by Leonora M. & M. Co. in 1917 amounted to 805 ft., according to manager, John Matson. East drift is in 1900 ft. from shaft. High-grade gold-silver-lead-copper ore has been opened.

Tintic.—Grand Central Mining Co. paid 5c. per share, equel to $25,000, on April 12. This makes $1,759,750 to date.

On April 8 the Tintic district Miners Union took a strike vote on the following grounds: "It is to the interest of all members to attend this meeting and vote for or against a strike, as all loyal Americans realize that conditions imposed by the companies of this district will not permit us to support our Government as we desire. Up to this time we have received but one communication recognizing us as citizens, organized in a bona fide labor organization, recognized by our Government." The men also demand an increase in wages of 50c., recognition of the union, abolition of the rustling card, and no more assignments of wages. Present minimum wage for skilled men is $4.25 to $4.50.

On April 6 the Chief Consolidated, Eagle & Blue Bell, Centennial Eureka, Gemini, and Ridge & Valley mines announced a 25c. raise in wages, to take effect May 1. Semi-monthly pay-days are also to be started.

Whiterocks.—Cedar Butte Oil Co., in the Uintah basin, is to build a 300-ton plant to treat saturated oil-sand. Oil is to be extracted by a hot solvent. P. S. Coke is managing director.

WASHINGTON

Boundary.—Maple Leaf mine in Stevens county, 2 miles from the international border, is being developed by Melrose Mining Co.—Spokane and Boundary people. F. M. Ludell, of the latter place, is vice-president. F. A. Heinze is said to have spent $50,000 in exploration, and cut the vein in a 2000-ft. adit. After he retired, others found ore by driving 10 ft. farther. Some rich copper-silver ore has been exposed. Machinery is to be ordered when roads permit hauling.

Northport.—The Electric Point Co. in 1917 received $553,522 from ore sales. Expenses totaled $219,120. Net profit was $80,129, all being paid in dividends. Difference is accounted for in $243,019 written off for depletion of ore and $7282 for depreciation. Ore blocked out is estimated at 15,000 tons. At the mine the shaft is down over 700 ft. on its way to 1000 ft. depth. On the 200-ft. level there were five 'chimneys' of ore, but on No. 6 only one has been opened so far, although equal to the upper levels. Carbonates predominate, but sulphides are expected at water-level, probably above 1000 ft. Ninety men are employed. Shipments continue to the Northport smelter. R. A. Young is manager.

CANADA

Ontario

The third year's operation of the Ontario Workmen's Compensation Act shows for 1917 that compensation totaled $2,913,086, against $2,011,469 in 1916. Accidents of all

kinds amounted to 36,514, an increase of 10,422. There were 454 fatalities. These figures relate to all industries. Expenditure by the administration was $133,630.

Cobalt.—Work in the Lightning River district has been suspended, except where special permit is granted by officials of the Mines Department. The gold discovery is situated within the timber limits of the Abitibi Power & Paper Co. At the present time an inspector is on his way to the area to study the situation.

Porcupine.—The West Shining Tree gold district, 20 miles south-west of Kirkland Lake, is reported to be very active. At Cashbow station on the Canadian Northern there is 100 tons of supplies awaiting transport to the field, a distance of 30 miles. The Wasapika, Churchill, and Kingsley properties show good ore. These, with the Burke-Bullock, Caswell, Holbrook-Tour, Holden, Atlas, and Longtyne, are being developed.

A feature in the goldfields of this Province is the large number of changes in the management of the various mines. Notable among these is the Hollinger, Tough-Oakes, Schumacher, Teck-Hughes, Dome Lake, West Dome, and Kirkland-Porphyry. At each of these, since the beginning of the year, changes have been made.

CHILE

The law covering taxation on exportation of copper and iron states that for ten years after the date on which the law goes into effect mine-owners must pay the Government 5% of annual profits, 36c. (U. S.) per ton on iron ore (with certain return privileges), 5% when blister copper is worth $291 to $388 per ton, 5% plus 6% between $388 and $485 and over, 11% for over $485 plus 7% of the excess in price over $485 per ton, same taxes for electrolytic, save that the low limit is $267 per ton, and ore and matte pays half the corresponding taxes for bar copper. Taxes collected are to be spent in aiding the mining industry. During period of present War, copper in form of metal, matte, and ore will pay as above, based on $388 per ton, plus 8% on excess over that price. Electrolytic will pay same rate of 8% based on minimum of $340 per ton.

Sewell.—The Braden Copper Co. produced 5,248,000 lb. in March, compared with 4,754,000 and 6,200,000 lb. in February and January.

MEXICO

Aguascalientes

Aguascalientes.—The American Smelting & Refining Co. has decided to make a voluntary contribution of $1600 gold monthly over a period of one year to the State of Aguascalientes, to expedite restoration of stable government. In return the State authorities have annulled a law by which attempt was made to levy a production tax of $9000 on the output of the smelter. Rather than submit to this impost the company had suspended operations at this plant and brought suit against constitutionality of the law in the Mexican Supreme Court. The suit will now be dropped and smelting activities resumed.

Chihuahua

Chihuahua.—The Chihuahua smelter of A. S. & R. Co. has been blown-in after a long suspension due to operation of bandits in its territory. The company has in progress reconstruction work that will greatly expand its capacity at Chihuahua, including erection of new copper smelter and lead plant.

Sonora

Cananea.—Greene Cananea produced 4,480,000 lb. of copper in March, against 3,960,000 lb. in February, 3,130,000 lb. in January, and 1,650,000 in December. Silver output in March was 130,400 oz., and 1225 oz. gold.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Samuel H. Dolbear is in Oregon.

B. B. Gottsberger has returned to Miami from New York.

D'Arcy Weatherbe is at Toronto, on his return from London.

James P. Gaskill has an office in the Security Bdg., in Los Angeles.

R. B. McGinnis is at Alice Arm, British Columbia, for the summer.

A. P. Root, of Silverton, passed through San Francisco on his return from San Diego.

J. L. Bruce has returned to Butte after a visit to Ray, Hayden, and Globe, in Arizona.

F. A. Fahrenwald, of Cleveland, is inspecting deposits of secondary minerals in California.

Clarke Sullivan is Captain in the Engineer Officers Reserve Corps, and is now at Metcalf, Arizona.

D. M. Kerr has accepted an appointment with the Broken Hill South company at Broken Hill, N. S. W.

Charles H. White is now Captain in the Officers Reserve and is stationed at Watertown, Massachusetts.

R. G. Hall, general manager to the River Smelting & Refining Co., St. Louis, was here during the week.

John Tait Milligan has been made general manager for the Afterthought Copper Co., relieving **J. T. Robertson.**

John E. Hardman and **J. Stevenson Brown** have been elected honorary life-members of the Canadian Mining Institute.

L. W. Ledyard, formerly manager of the Teck Hughes at Kirkland Lake, Ontario, has been appointed general manager of the Kirkland-Porphyry mine.

W. J. Sharwood is chemist, and **Allan J. Clark** is metallurgist, to the Homestake Mining Co. This is to correct an error made in a recent issue of this paper.

George Baer, for a number of years mine superintendent for the Socorro Mines Co., Mogollon, New Mexico, is leaving to take a position with a large copper company in Cuba.

Frank H. Sistersmans will shortly return from Cuba, where he has been managing manganese mines for Eastern people, and will make his headquarters at El Paso, Texas.

Robert M. Keeney, manager for the Ferro Alloy Co., at Denver, Colorado, is acting as consulting engineer for the Anaconda Copper Mining Co. at its new plant for making ferro-manganese.

A. G. McGregor, smelter construction engineer, has been at La Fundición, Peru, investigating the proposed alterations to the Cerro de Pasco works. He is also to visit Chuquicamata and Sewell in Chile.

Kuno B. Heberlein has resigned as president of the Compañia de Minerales y Metales, Compañia Minera de Penoles, and Compañia Minera de Paloma y Cabrillas, Mexican subsidiaries of the American Metal Company.

Thomas Treloar, well known at Butte, Montana, died on April 2. He was born in Cornwall in 1842, coming to the United States in 1886. He had been connected with Butte mines since 1888. He leaves three sons, a daughter, and a wife.

E. E. Barker, who has been mining superintendent for the Chile Exploration Co. at Chuquicamata, Chile, since the beginning of work at that property, has resigned his position to become superintendent of mines for the Cerro de Pasco Copper Corporation at Cerro de Pasco, Peru. After spending a few months in New York, Mr. Barker has again returned to South America.

THE METAL MARKET



METAL PRICES

San Francisco, April 16

Aluminum-dust (100-lb. lots), cents per pound	70
Aluminum-dust (ton lots), cents per pound	65
Antimony, cents per pound	15½
Antimony (wholesale) cents per pound	13¼
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7¼— 8¼
Nickel, cents per pound	55
Platinum, pure and with 10% iridium, per ounce	$108—$116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	10
Zinc-dust, cents per pound	17½

The platinum situation at San Francisco was discussed here last week by the Manufacturing Jewelers' Association. It was found that there is only 100 oz. of the metal here, and the jewelers voted to give the Government first call on 50 oz. at $108 per ounce.

ORE PRICES

San Francisco, April 16

Antimony, 45% metal, per unit	$1.10
Chrome, 38% and over, f.o.b. Cal., per unit	$1.25
Magnesite, crude, per ton	$8.00—10.00
Manganese, 40 to 50%, cents per unit	92—110
Manganese, chemical, per ton	$80—100
Tungsten, 60% WO_3, per unit	$20— 24
Molybdenite, per lb., 85% MoS_2 (nominal)	$1.80
Pyrites, domestic, per unit of sulphur, cents	28

Magnesite deposits in Venezuela are to be developed on a large scale by the Magnesite Products Corporation, of which Chas. E. Doddridge of New York is president. Estimated quantity is 300,000 tons, averaging 48.31% MgO, 0.43% Fe, 0.44% CaO, and 50.03% CO_2. The ore is on the coast, and will be mined by open-cut. Shipments of 1000 tons monthly to America are contemplated.

EASTERN METAL MARKET

(By wire from New York)

April 16.—Copper is unchanged. Lead is dull, though steady. Spelter is inactive and lower.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67c. for small lots, effective until June 1, 1918. Quotations in cents per pound are as under:

Date		Average week ending	
Apr. 10	23.50	Mch. 5	23.50
" 11	23.50	" 12	23.50
" 12	23.50	" 19	23.50
" 13	23.50	" 26	23.50
" 14 Sunday		Apr. 2	23.50
" 15	23.50	" 9	23.50
" 16	23.50	" 16	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

SILVER

Below are given official or 'ticker' quotations, in cents per ounce of silver 999 fine. The actual figure at which the metal is bought and sold is a matter of negotiation, and is not available, but the prices given indicate such approximately. Premiums are paid, up to 3c. per oz. See 'M. and S. P.' of March 23, 1918, for full details.

Date		Average week ending	
Apr. 10	91.37	Mch. 5	85.12
" 11	93.37	" 12	85.66
" 12	93.37	" 19	86.71
" 13	93.37	" 26	91.27
" 14 Sunday		Apr. 2	92.12
" 15	95.25	" 9	91.74
" 16	95.62	" 16	93.73

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

The silver bill before Congress is, briefly, to retire silver certificates, to borrow from the Treasury the silver for use for war purposes, and then, as silver from time to time comes on the market, to replace the silver so borrowed by purchase in the market at the fixed price of $1 per fine ounce and to replace the borrowed silver by coining the new silver acquired for that purpose into standard silver dollars. There is no limit in which this must be done. Commenting on this proposal, the four principal bullion brokers in London—Samuel Montagu & Co., Mocatta & Goldsmid, Pixley & Abell, and Sharps & Wilkins—as stated in the 'Financial Times,' is briefly as follows: (1) "The most important event that has occurred in the silver market for some time past"; (2) "That the release of so much silver should be treated as a 'bull' point strikes one as an anomaly, and it would be so were it not for the fact that the bill is to provide for the gradual re-purchase by the American government of this silver at about $1 per oz., which, of course, is considerably higher than any price ruling for some time, and the anticipation of this naturally stiffens the backs of sellers and encourages them to hold off"; (3) "The addition of silver made available should be sufficient to meet all requirements for some time"; (4) "More buying in London has been induced."

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date		Average week ending	
Apr. 10	7.00	Mch. 5	7.33
" 11	7.00	" 12	7.25
" 12	7.00	" 19	7.25
" 13	7.00	" 26	7.25
" 14 Sunday		Apr. 2	7.19
" 15	7.00	" 9	7.13
" 16	7.00	" 16	7.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

Lead at Joplin, Missouri, remains at $85 per ton, basis of 80% metal.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Mch. 19	115.00	Apr. 2	105.00
" 26	115.00	" 9	115.00
		" 16	117.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	....	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Tin valued at $2,000,000 arrived at San Francisco from the Orient by the 'Korea Maru' on April 10.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Apr. 10	7.00	Mch. 5	7.91
" 11	7.00	" 12	7.79
" 12	7.00	" 19	7.75
" 13	7.00	" 26	7.56
" 14 Sunday		Apr. 2	7.33
" 15	7.00	" 9	7.23
" 16	7.00	" 16	7.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Zinc-ore prices at Joplin, Missouri, dropped $5 per ton last week. On 60% basis the range was from $40 to $55, most ore selling at $45 per ton.

Commenting on metal markets in 1917, the A. S. & R. Co. states that the peak of high prices, save that of zinc, was reached during the first half of the year. Since then there have been serious declines, as follows: copper from 33 to 23½c., lead from 11 to 5½c.; silver from $1.09 to 78c., and spelter from 13 to 7½c. These results, it said, have been partly brought about by Government actions.

Eastern Metal Market

New York, April 10.

Two of the metals have developed further weakness; inactivity is pronounced in all of them.

The copper market is devoid of interesting features and is unchanged.

It is still difficult to do any business in tin for future delivery, and spot metal is practically unobtainable.

Lead has declined sharply and demand is very light.

Zinc continues to weaken and is lower than a week ago.

Antimony has softened and is in poor demand.

The most significant development of the week in iron and steel is the definite shaping of Government plans for the immediate building of larger gun-works than now exist, also for a corresponding increase in the manufacture of the largest shells in these new plants. This will include many 16-in. howitzer mounted trucks, to be made by a great concern not now engaged on guns, and for delivery late in 1919 or early in 1920. This vast enlargement in our offensive preparations, revealed in the last two weeks, has stirred the machine-tool trade also. The first week in our second year of war clearly indicates that the American steel output will finally be almost entirely absorbed, to the exclusion of so-called ordinary uses at home or abroad. The steel-ingot output in March is estimated at 3,525,000 tons, based on returns from 29 companies, making 85 to 90% of the entire output. This parallels the remarkable recovery in pig-iron output made in March.

COPPER

General conditions remain unchanged from last week or some weeks previous, and the market is featureless. On what appears to be good authority we learn that one of the biggest men in the copper industry has recently returned from conferences at Washington more convinced, or more confident, that the price of copper will be 25c. per lb. after June 1. The country's production is increasing each week, and will probably equal 200,000,000 lb. in April. This is based on the reports of several large companies for March, showing a decided increase. Some predict an output of 225,000,000 lb. per month inside of two or three months. At present there is a demand for all that is being made, the supply about balancing this. Exports have declined on account of lack of vessels. The question of refining costs is a disturbing one. These have increased through the advance in wages in contiguous industries. It is a question that will demand thoughtful consideration soon, as contracts for refining have not advanced. In response to inquiries for delivery before June 1, producers show an unwillingness to quote.

TIN

There has not been much change in the situation since last week. There is still a pronounced scarcity of sellers, while the number of buyers is large and the desire to buy strong. This has resulted in an advance in prices all around, that is, for future delivery, to 78 and 78.50c. per lb. for future shipment from the Far East for Straits metal. Other brands are correspondingly high. Business during the past week has been small. It has been and still is next to impossible to do business, delay in cables being one of the reasons, also the lack of sellers. Spot tin continues inordinately scarce, with the quotation nominal at 85c., New York. For a 5-ton lot, a higher price has been bid in the last day or two. Deliveries of tin at the Pacific Coast for March are now available. They were 3451 tons, making the month's deliveries 5151 tons. This is larger than for some time, and contrasts with an average monthly delivery of 4140 tons for the five years previous to 1918. In 1917 they amounted to 4823 tons per month, and in 1913, 3658 tons. Imports for the first quarter were 12,828 tons, against 15,762 tons in this period of 1917. Straits tin accounted for 7822 tons of the 1918 receipts. The total visible supply on March 31 last was 15,887 tons, against 20,307 tons a year ago. These figures indicate the large consumption in this country. Arrivals to April 7 were 170 tons, with 5000 tons estimated as afloat. Spot Straits was quoted at £319 10s. per ton yesterday in London, or £2 higher than a week ago.

LEAD

The market is a narrow one, but while it has declined during the past week, it still contains an element of strength. It has been forced down by lack of demand and has reached 7c., New York, for early delivery in the outside market, with the St. Louis level at 6.90c. There is a decided lack of interest, otherwise 7c. lead would be quickly absorbed. It is a fact, however, that some leading sellers have no metal to offer, and that one large independent producer has shut-down because of labor difficulties. The A. S. & R. Co. has not changed its quotation of 7.25c., New York.

ZINC

The market continues to sag, and apparently has not yet touched bottom, though last week it was thought it could not go lower. Sales of prime Western for early delivery were made today at 7 to 7.12½c., New York, or 6.75 to 6.87½c., St. Louis. One dealer reports a lot of several hundred tons sold yesterday at 7.05c., New York, for early delivery. One large company is quoting 6.75 to 6.87½c., St. Louis. The market is rapidly approaching a crisis, and some say openly that it is to be a battle for the survival of the fittest. While sales have not been large at the lower levels, they have probably been induced by a desire to cash-in. It is a fact that several large producers are curtailing their output considerably. The quarterly report of the U. S. Geological Survey is anxiously awaited.

ANTIMONY

Very little metal is being offered, and demand is also light. The market is quoted at 12.75 to 13c., New York, duty paid, for Chinese and Japanese grades for prompt and early delivery.

ORES

Antimony: No developments are recorded and the quotation is nominal at about $1.75 per unit.

Ferro-silicon: The high-grade 50% ferro-silicon market is fairly active at $155 to $165 for forward delivery, with as high as $180 to $190 asked and obtained for spot and early delivery. There are now several new producers of the alloy in this country.

Manganese: Manganese ore imports in February were much larger than expected. They amounted to 56,289 gross tons, compared with 29,796 tons in February 1917. March imports are not expected to exceed 25,000 tons. Ferro-manganese imports in February were only 1417 tons, against 6379 tons in February 1917. Exports were 632 tons, unusually large under the circumstances.

Molybdenum: Molybdenite is nominal at $1.80 per lb. of MoS_2 in 80 to 90% concentrate. The market is quiet.

Tungsten: An interesting fact is that ore from a British possession in the East was imported in February for the first time. The market has been active, sales of imported ore having been made covering all of 1918 at $24.50 for scheelite and $24 per unit for wolframite. Ferro-tungsten is quoted at $2.25 to $2.40 per lb. of contained tungsten.

INDUSTRIAL PROGRESS



INFORMATION FURNISHED BY MANUFACTURERS

RAINBOW DIVISION, SPECIAL LIBERTY LOAN COMMITTEE

The Machinery and Tool Trades are represented in the Third Liberty Loan campaign by a special organization that covers the field indicated by the title. It is one of the largest fields, industrially considered, that the country holds. So wide is it that the further designation of 'Rainbow Division' is fully justified; it includes 'all colors.' This reminds us of a duty to follow up that band of gallant soldiers who led the way to France as the vanguard of the American Army that is steadily streaming across the ocean. This first band of warriors was symbolic of the new hope for a free world and the promise of its fulfilment; hence it was composed of representatives of every State in the Union, men of every shade of the national colors, blended in this 'Rainbow Division' of the Army of Freedom. So this committee represents a host of makers of the tools with which man works and with which he fights to preserve his civilization; it is, accordingly, a blende of all the colors of American industry, pledged as another rainbow of promise that America will not fail the boys that have gone to France. The officers and members of the committee are given in full below. The address of the secretary and the publicity director is at 334 Fourth Avenue, New York, where offices have been opened for subscriptions.

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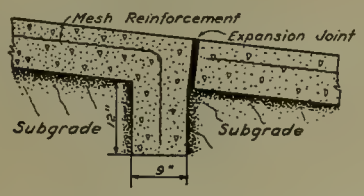
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BUILDING CONCRETE ROADS ON GRADES

By H. Eltinge Breed

In many parts of the country horse-drawn traffic is becoming negligible. Statistics indicate that the motor truck will increasingly be the means of transportation between centres for short-haul freight and between the farm and market-place. For such heavy motor-truck traffic the concrete pavement, because of its durability, is desirable even on grades of 9%, or possibly 10%. The work should proceed from the bottom of the grade up-hill in order to get the best results. This will permit the operation of screeding without the waviness that would come in the pavement from working down-hill. It is essential that a reasonably dry mix should be used. However, it should not be so dry that tamping is necessary. Care and a little experimenting in the field will give the exact amount of water necessary to make a proper mix. Particular care should be taken to place all joints perpendicular to the surface. In order that they may ride smoothly, it is advisable that the joint material be placed about one half-inch below the surface, so that the screeding and necessary floating may be continued over the top of the joint to make the surface smooth. When the cracks come at the joints, the spalling can be done by pouring the tar and sand. There should be as little screeding as possible to secure the necessary surface on the concrete, and the floating should be minimized, because, by tending to bring the finer particles of material to the surface, they give the undesirable smooth top; whereas the whole object in screeding and floating is to get the greatest amount of density with the stone at the surface in such a way as to check the flow of the concrete already laid. The surface should be broomed. This will, for a time, give the pavement sufficient roughness to hold traffic fairly well. It has been suggested many times that concrete on grades be scored or marked; but as it is only a short time before these scorings or markings are worn smooth, the extra cost of the work is not commensurate with the results.



NON-CREEPER EXPANSION JOINT.

Another difficulty encountered in the construction is a tendency of the concrete slabs to creep down-hill with the grade. In some cases this has resulted in the lower end of the slab rising slightly above the end of the next succeeding slab. Where the joints have not been absolutely perpendicular to the surface, shattering has occurred. In order to prevent this tendency to creep, I have designed a non-creeper joint which is now being tested in construction work to determine its possible advantages. There must be some type of joint that will offset this tendency to creep.

It is certain that this type of surface is less slippery than any of the bituminous macadams, laid either by mixed or by the penetration method. It is also known to be less slippery than the ordinary brick surface, excepting, of course, the hillside block. So far as my observation goes, it is not more slippery than the new-laid grouted granite block. Except for draught animals, it is not more slippery than the old-style open-joint granite-block pavement. It is more slippery than the ordinary water-bound macadam, but the comparison is unfair, first, because water-bound macadam is suitable only for light traffic, and, second, because after a water-bound road has been oiled or tarred, as is frequently necessary to keep it in good condition, it is extremely slippery. Slipperiness of the concrete surface can in large measure be reduced by proper selection of aggregates and by the use of coarse sand, together with the care in construction suggested above, the proportions being such as will give the greatest density.

SOUTHERN INDUSTRIAL RESOURCES

Arthur D. Little, of Boston, has re-published in pamphlet form an interesting address which he delivered at a meeting of the American Chemical Society in New Orleans, in the course of which he said:

The U. S. Geological Survey estimated the minimum available power in 11 of the streams which have their headwaters in the southern Appalachian mountains at 2,800,000 hp. The estimate for all the streams of the South has been put at about 5,000,000 hp. Only about one-fifth of this power has been developed and of this amount nearly 800,000 hp. is in the five States of Alabama, Georgia, North Carolina, South Carolina, and Virginia. Georgia alone has available 500,000 hp. The South has inexhaustible supplies of clays which exhibit every desirable range of quality. There are clays in any amount desired for the making of common brick and tiles, cheap pottery and drain pipe, terra cotta and paving brick, and prodigal amounts of the finer white plastic clays and kaolins for china and the purposes of paper making. The production of fuller's earth is almost exclusively a Southern industry. Immense deposits of gypsum occur in several Southern States, and ochres, mica, graphite, barytes, and corundum are among the well-known mineral products of the South. The history of industrial chemistry is a record replete with romance and one of its best known stories is that which chronicles the development of the aluminum industry. In 1855 the metal cost $90 a pound; the Castner process brought the price to $4 in 1889. Then Hall in America and Heroult in Europe simultaneously developed the process which permits its cheap production by electrolyzing alumina in a fused bath of cryolite. Bauxite is an impure alumina and has become the chief source of the metal. Arkansas leads in the production of bauxite but Georgia, Alabama, and Tennessee contribute largely to the growing demands. Another romance of chemical achievement is that which tells the story of the sulphur mines in Calcasieu parish, Louisiana. There sulphur in inexhaustible amounts lies 1000 ft. below the surface and under 500 ft. of quicksand. An Austrian company, a French company, and many American companies had tried to work this deposit, but each failed. Frasch solved the problem by forcing superheated water down a boring and pumping out the melted sulphur through an inner tube. Today Louisiana holds within her hands the sulphur markets of the world and supplies one-half the world's consumption. Sulphur, as the direct source of sulphuric acid, constitutes the foundation of all chemical industries. The keystone of the structure is common salt. This the South bountifully supplies at Avery's island, also in Louisiana, and in the salt wells of Oklahoma and West Virginia.

The largest sulphuric-acid plant in the world is at Ducktown, Tennessee, but the striking feature of the installation which holds this record is that the acid is made from smelter fume, which commonly in other plants goes only to create a nuisance. The copper production, which is the primary output of the plant, is over 18,000,000 lb. per year. The largest copper-refining plant in the world is at Patapsco, Maryland, with an annual production of 200,000,000 pounds.

In 1911, 42% of the lead output of the country came from the South and 41% of the zinc production. The largest pyrites plant in the country is in Louisa county, Virginia.

There are produced in the United States 57 useful minerals. Of these every one is mined in the South except platinum and borax.

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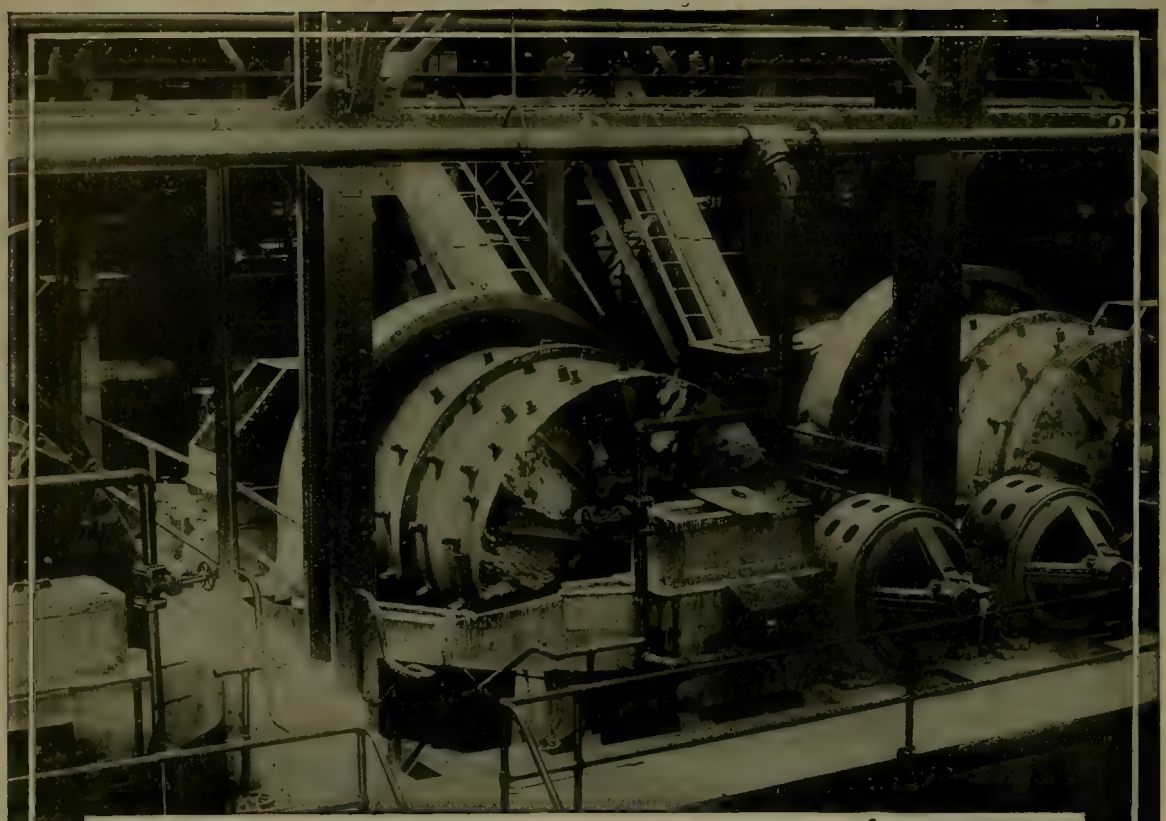
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Practically standard construction was selected for these motors, and the selection has been justified during the last two years by an operating record which has been successful in every respect and the basis for large repeat orders.

Hundreds of grinding mills are driven by G-E motors. Among those using these motors are the Calumet & Hecla Mining Company, the Anaconda Copper Mining Company and others equally well known.

General Electric Company

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7473



WE quote the preamble of the President's recent proclamation: "An enemy who has grossly abused the power of organized government and who seeks to dominate the world by the might of the sword, challenges the rights of America and the liberty and life of all the free nations of the earth. Our brave sons are facing the fire of battle in defense of the honor and rights of America and the liberty of nations. To sustain them and to assist our gallant associates in the War, a generous and patriotic people have been called upon to subscribe to the Third Liberty loan.". The response has been splendid; it only remains to make it overwhelmingly successful in order to prove that the whole people is a unit in standing behind our army, which is now in action and playing an increasingly helpful part in stopping the German onslaught and, let us hope, in preparing for an effective counter-offensive.

THE Webb bill, which has now become law, directly authorizes combinations of manufacturers and sellers, and the pooling of the interests of producers and distributors in this country with respect to international trade. This is intended to meet conditions that are expected to rule in foreign commerce after the War, patterned after the kartel, an officially recognized industrial aggregation for trade expansion.

ACCORDING to good authority, the money spent annually in ready-made women's garments runs to $2,500,000,000. It is probable that $1,000,000,000 of that could be saved every year. Now is the time to do it. Here, as in England and in France, not to mention Germany, any true woman ought to be ashamed of spending money on needless adornment when so many are in mourning all over the civilized world. Changes of style are a satire on this pentecost of calamity.

CONCRETE has been applied successfully to the building of ships. This fact is represented by the 'Faith,' the first concrete ship launched in America. We publish a short account of the method of construction and we may add that the shipyard in which the 'Faith' was built cost only $22,500 in money and one week in time—and time is the principal element in the equation that represents our part in the War. The 'Faith' was launched in six weeks from the day concrete was poured into the frames embedding the continuous basket-work of welded steel. It is interesting to note that search is being made for volcanic scoria and porous basaltic rock for the purpose of making concrete of light weight suitable for ship-building.

ANNOUNCEMENT is made that the National Lead Company, of New Jersey, and the Williams Harvey Company, of England, have organized the National Lead Company of Argentina, to manufacture mixed metals in the Argentine republic. This step has been taken at the instance of Mr. Simón I. Patiño, the Bolivian tin magnate, who has acquired a one-third interest in both of the parent companies of this new venture. The leading motive has been the growing market in South America, especially in the Argentine, where the high tariff on alloys has necessitated domestic production.

FIXATION of the price of pyrite at 30 cents per unit of the sulphur contained, has been proposed at a conference between the War Industries Board and the Chemical Alliance. The present price for domestic pyrite at the mills ranges from 28 to 30 cents. It is estimated, on the basis of the existing rate of sulphuric-acid manufacture and of pyrite production, that the shortage of sulphur for 1918 will amount to 2,500,000 tons. It is thought that an assured price of 30 cents per unit for two years will encourage the mining of pyritic ores so as to make good a large part of the threatened deficiency.

ON several occasions the attitude of President Irigoyen has led to our questioning whether the Argentine republic might be counted well-disposed toward the cause of the Allies. All doubt of the friendship of that country is removed by the conclusion of an agreement whereby the Argentine surplus of wheat, amounting to 2,500,000 tons, or approximately 84,000,000 bushels, is to be delivered to England and France at a price of $1.44 per bushel free on board ship in Argentine ports. Thus a large quantity of wheat will reach the consumers abroad at a price scarcely higher than that established by the Food Administration in this country. The United States has accepted concourse in this international arrangement by agreeing to release the coal needed in the Argentine, in so far as such withdrawals may not

prejudice our own industrial operations. The understanding thus reached between the four Governments has been styled most felicitously by Señor Luis M. Drago, the originator of the so-called 'Drago Doctrine,' as "an evidence of political favor to the Allies." President Carranza, please take notice!

FROM Cobalt we hear that the principal mining companies in that Canadian silver region have shown their faith in the slogan 'Food will win the War' by engaging in voluntary agriculture. For example, the Buffalo Mines company has acquired a tract of 20 acres about two miles from the mine with the purpose of enabling its employees to use their leisure time in producing crops, which will be divided among those doing the work. The idea is a good one and we commend it to mining companies elsewhere, particularly in regions more fertile than the sub-arctic waste in which Cobalt is placed. Let the Californian thank God for his climate and plant potatoes!

AMENDMENT of the Pittman silver bill, as made by the Senate Banking and Currency Committee, increases the amount of silver coin to be melted into bullion to a total of $350,000,000. This will be good news to Utah, Montana, Idaho, Nevada, and the other States that are prominent for their output of the white metal. An assured price of $1 per ounce for nearly five times as much silver as was produced in the whole United States during the year just past, is a substantial encouragement for the expansion of the industry. There is a sardonic kind of humor in it, however, since necessarily the price is fixed in terms of gold, and the value of the gold dollar, measured by its purchasing power, is only about 54 cents, as compared with market quotations in 1914. Therefore the new legislation will barely restore silver to the position it held four years ago, when the average price was 55.3 cents per fine ounce. Without governmental support the country would have been reduced almost entirely to dependence upon such silver as might have been obtained as a by-product in the treatment of lead and copper ores. As we go to press we learn that the bill has passed both houses of Congress and only awaits the President's signature; meanwhile the quotation for silver has risen to a dollar at New York.

NORMALLY, when silver stood at 25 pence at London, the price of silver in New York was $\frac{3}{16}$ of a penny, or $\frac{3}{8}$ of a cent, less per ounce, because the market for the metal is centred at London and the fractional difference in price represents the cost of transport and insurance. At the present price this difference is doubled. Similarly at the present time there is a difference of about 3 cents per ounce between New York and San Francisco, the higher price on this coast being due to the fact that the cost of insurance against war-risk on shipments from New York by way of London and the Mediterranean route is considerably greater than the same tax on direct shipments to the Orient, say, from San Francisco to Bombay, the latter being the great chief Indian centre of silver brokerage. The element of time, involving interest on money, also favors San Francisco as the distributing point for the great sink of silver in Asia, now that so many more steamers are running between San Francisco and the Orient, as compared with the Mediterranean route.

COULD anything better illustrate the growth of our national appreciation of responsibility than the development of the nitrate industry under Government control? Truly the country is waking up. Anything the War Department says it needs it will get, and it is now proposing an additional expenditure of $500,000,000 for more nitrate plants. Compare this figure with the $20,000,000 appropriated for the purpose two years ago, and consider that the imagination to grasp the needs of actual warfare for perpetuating our democracy has increased, in this instance, 2500%. That is a substantial gain in the education of our officials. It is worth recalling, too, that friends of the Kaiser tried to befuddle the authorities at Washington, telling them gravely that careful experiments should be made in advance of spending so vast (?) a sum as $20,000,000 on a Government nitrate plant, and they had almost succeeded in splitting the appropriation into parcels, to be frittered away, along with our precious time, in a lot of research work. We were assailed, at the time, by these same Teutonic sympathizers, for publishing the truth, but now the Government is rushing the work on cyanamid plants, and on others in which the Haber process will be employed, following practice that needed no further experimental demonstration, while the War Department is calling for 25 times as much money as was originally appropriated for producing this essential in the making of explosives and of food.

The War Minerals Bill

The legislation proposed for the purpose of stimulating the production of the minerals needed for the War is generally approved by the mining public. Originally the bill was so comprehensive as to cover all ores and minerals, including the principal base metals and the two precious metals; in effect it would have created a central administration for the mining industry comparable with that of the Food Administration in relation to agriculture and live-stock. Any such control of the mining industry as a whole provoked opposition, particularly from those engaged in the mining of copper, lead, and zinc. The bill as amended is much less ambitious, indeed it applies only to the metals and minerals normally imported, it aims to stimulate the prospecting and development of products hitherto sought abroad. The list as it now stands, and as quoted by us last week, represents a small and unimpressive fraction of the output of metals and minerals constituting the normal production of mines in the United States. Briefly, it applies to what may be called the 'secondary' minerals, made of prime importance by reason of our intensified manufacture of guns and munitions, tool-steel, and chemicals, especially

such as came formerly from the enemy countries. It is a measure designed not to stimulate commerce but to aid war; it is an emergency measure. Some of the mineral products needed at this critical time occur in nature usually in small deposits, for example, those of chrome and tungsten; it is necessary not to support but actually to create an industry capable of furnishing an adequate supply of such steel-making ingredients. Before a start can be made to exploit the numerous, but small, deposits of such minerals, it is necessary to assure the prospector and mine-operator that he will find a market ready for his output, and such a market cannot be guaranteed so long as the price is subject to the resumption of importation after the War, the duration of which no man can foretell. In short, a guaranty is required before a start can be made. That guaranty this bill provides. The Government, in the name of the President, is authorized "to purchase any of these necessaries for which a guaranteed price shall be fixed" under Section 14, and "to hold, transport, or store, or to sell, dispose of, and deliver the same to any citizen of the United States or to any Government engaged in war" with Germany, "or to use the same as supplies for any department or agency of the Government of the United States." A sum of $50,000,000 is to be provided for the purpose of putting the Act into effect. The time limit is two years. We hope that this limit will be extended, because it may prove insufficient for the starting and establishment of some of these minor mineral enterprises. The British government enacted similar legislation for a period to extend until two years after the War. This means a minimum of two years, and it is reasonable. The fixing of minimum prices and of the minimum time during which they are to be effective is intended to stimulate the search for necessary war minerals and to encourage the production of them. Manifestly such stimulation and such encouragement will be lacking if the time element is too scant, as, we submit, would be the case if two years should prove to be the maximum, as well as the minimum period; because the last section of the Bill specifies that it "shall cease to be in effect after the existing state of war between the United States and Germany shall have terminated." That, of course, is an event the date of which no man can determine; when it happens, the national emergency will have passed, but if we are to create new mineral industries it is highly desirable that they should be aided until such time as they can compete successfully against foreign competition; in short, we would like to see not only domestic production of war minerals but the establishment, on a sound basis, of mines and metallurgical plants able to furnish as many as possible of the materials previously imported largely from the enemy countries. If we have the resources, why should this country be dependent on foreign sources of supply? Another important matter is that of defining "reasonable" prices. We presume that the administrator to be selected to control this new department at Washington will be a man experienced in mining and aware therefore of the risks inherent to mining. This suggests the question of the profit-tax. If fair prices are fixed, such prices as will warrant the organizing of new enterprise, will the tax on profits be so heavy as to kill the benefit accruing from the stimulus given by the fixation of price? Risk is inherent to mining; the risk is much greater than in manufacturing, despite all the gush printed by irresponsible promoters, whose money comes not from the ground but from the gullible public. A 50% profit per annum might be wholly insufficient to justify the expenditure incurred in finding a small deposit of manganese or of mercury, for it might be exhausted before the working-capital had been recovered. We do not wish any part of the community to enrich itself immoderately at the expense of the Nation at this time, but if it be the Government's desire to stimulate certain branches of mining it is obvious that a monetary gain must be promised to those willing to incur the risk. The matter in hand is not one of charity, nor only of patriotism, but of business, and it must be faced frankly in that spirit in order that the desired results may be obtained effectively and promptly. Some assurance in regard to taxation therefore is quite as much needed as in regard to prices; the left hand of the Government must act in harmony with the right, otherwise the purpose of the present legislation may be balked. Another decisive factor is labor; any price-fixing must pay due regard to current wages. Mining enterprise has to compete for labor against the demands of the Army and Navy, and against that of the cost-plus-10% contractors operating on Government account. Obviously the continued rise in wages might cancel the benefit, to the mineral-producer, of any price-fixing by the Government. As we said at the start, the sentiment of the mining community is favorable to the proposed control and the intended stimulus; we hope that those interested, producer and purchaser alike, will join hands in expediting this supremely useful departure.

The Zone Postal Rate

Periodicals will soon be subject to a progressively increasing tax that will reach nine times the present rates of transportation.

Taxation takes something from a man after he has acquired it. In a republic the levy is intended to be for his welfare, through protecting him in the opportunity to live, to labor, and to develop the opportunities that lie before him. To a certain extent heavy taxation limits his power of initiative and expansion as an industrial factor, but he must submit to what is necessary to sustain his Government in its paternal duty of guarding him and his heritage from the Enemy. A peculiar merit inheres in a direct tax because a man is conscious of paying it, and is thereby brought face to face with his responsibility as a citizen. It gives him a keen realization of the partnership with the Government that is involved in his being a citizen. Raising revenue by such taxes as the excise and customs duties possesses no educational value whatever; it tends to personal civic irresponsibility and promotes the growth of individual selfishness, both detrimental to patriotism.

It is worth while to note the distinction between the effects exerted upon a nation and the people composing it merely by the means adopted for raising revenue. Good civics is good ethics, and a tax that tends to produce a citizen having a superior regard for his obligations to the State, that tends to give him a sense of strong community interest in the Nation as a whole, is clearly a tax possessed of a desirable ethical quality. A tax that exerts an opposite influence is ethically wrong, and therefore is a national evil. We submit that one of the inherent centrifugal forces in that political association which constitutes the United States is the accentuation of State sovereignty and State loyalty. The Civil War was waged against the South's insistence upon State-rights, and the dominant North failed to republicanize the country when it had the chance. A Frenchman from the south of France may call himself a Gascon, but he cannot find a territorial sub-division in which to proclaim a gasconade loyalty. France, with its 86 departments, governed by prefects appointed by the President, accentuates the centripetal civic forces. We are not arguing for so radical a reform in our system of government, but we do insist that any form of taxation that furthers the sectionalization of the United States is not simply an error in policy but is fundamentally a moral wrong. Whatever we may think of the value of many nations, viewed from the broad standpoint of creative civic evolution, it is an evil for the race to nurture tendencies to separatism where once a people has been gathered contentedly under the stimulating opportunities of uniform national laws and the freedom of domestic exchange. In a nation, first and always, solidarity of interest must be cultivated.

In its inconsiderate haste the Congress of the United States has passed a law, which will become operative on July 1, 1918, that is a tax on national fellowship. It is a law that will promote the isolation of the different portions of the country; that will tend to make men Californians, New Yorkers, Georgians, Texans, Minnesotans, to a degree never known before. Although we once went to war to crush sectional thinking, sectional industrial interest, sectionalism of every kind, now we confront a tax-law destined to split us in our habits of thought and in our scope of industrial enterprise into groups of Northerners, Southerners, Westerners, South-Westerners. We refer to the tax on printed matter. Postage is a form of taxation, but it has been wisely limited in the past to an amount barely sufficient to cover the cost of administration. For the sake of easy communication the public has cheerfully made up the frequent annual postal deficits by special appropriation. Freedom of communication has been appreciated as a vital essential for cementing the people together, for permitting them to exchange ideas, for enabling the man in California to read the papers and magazines bringing to him the point of view of the Knickerbocker or the Quaker, and in turn for enabling the New Yorker and the Bostonian to catch the fresh inspiration of the States that front the Pacific and feel the pulse of an Oriental world. When the postage, under this iniquitous tax, doubles the cost of your 'Atlantic Monthly' or 'Collier's,' when you have to pay $20 per annum for your New York 'Times' delivered in San Francisco, or an equal sum for the 'Portland Oregonian' in New York city, when your 'Current Opinion' is reserved for those who live east of the Mississippi, and your 'Sunset' never carries its lesson to the dawn on the Atlantic, how the spirit of sympathy and understanding will be smothered between East and West! We even hesitate, as good Americans, when we write the words East and West, or North and South, to capitalize them, but this law will raise them completely to 'upper case.' Exchange of ideas, exchange of the printed page, is like the circulation of the blood of civic unity. We soon forget what our brother in Massachusetts thinks and feels if we do not hear from him; soon, if he loses touch with our intimate life, he becomes more self-centred than ever in his Beacon Hill exclusiveness. Why did our people not understand Mexico nor her revolution? Because of the barrier of language; yet a wiser Congress had tried to diminish the obstacles to communication by a postal reciprocity based on the domestic rates of each country. In time this facility for exchange of letters and of literature would have gone far toward breaking down the idiomatic barrier also. What did a wiser Congress in the past undertake in the interest of a closer drawing together of America and England? It authorized a postal treaty applying the domestic rates for communication across 3000 miles of ocean. These are examples of the sane efforts that thinking men have made to associate even separate nations in the spirit of developing brotherhood and co-operation. Once before, when this dangerous undemocratic zone system of postage had been tried, it was abolished by President Lincoln, whose wisdom has been approved by every postal commission since. The present Act was carried in Congress as a rider on the War Revenue Act without being submitted to the Postal Committee; it was rushed through nearly unnoticed by most people, concerned as they have been with the urgent business of war; yet this is not a war measure; it was deliberately planned as a permanent feature of the postal administration. Before its sinister influence can be exerted it should be repealed. It is calculated to throttle the free dissemination of information, to narrow the life of the people in the small eddies of sectionalism instead of sweeping them along in the broad current of nationalism, to encourage regional jealousies, and to weaken our national united resolve, which would expose us the more readily to the wiles of Teutonic propaganda. The increase of sectional spirit lessens our collective power as Americans, and plays into the hands of the Kaiser. If Representative Kitchin, the father of this infamous measure, has not reflected that, in foisting it upon the country, he unwittingly was playing the part of a pawn in the Hohenzollern game, it is time that he realized it and displayed his patriotism by introducing a bill to abrogate it. Let every good American insist that this law be set aside. Let him remember that there stands on the statute book a tax on patriotism that must be abolished, if the country of our fathers is to be preserved one and indissoluble.



Mr. Norris and Minerals Separation

The Editor:

Sir—In an article published in your journal on February 2, 1918, entitled 'Scientific Nominalism and Flotation Physics,' by Dudley H. Norris, it is charged that W. H. Ballantyne, patent agent for Minerals Separation Ltd., had access in the British Patent Office to the provisional specification of the Elmore vacuum patent at the time that he prepared and filed the British application for the basic froth-flotation patent No. 7803, filed April 12, 1905, and the suggestion is that he availed himself of this opportunity in the preparation of the Minerals Separation application. The statements in this regard are wholly false and unwarranted, and as Mr. Ballantyne is now serving his country in Mesopotamia as a major in the British army I think it only fair that I should correct them.

In the first place the Elmore provisional specification for the vacuum processs which was filed in the British Patent Office on August 16, 1904, No. 17,816, by Abel & Imray, British patent agents, and which remained in absolute secrecy there until the complete specification had been filed and accepted and passed to issue on October 16, 1905, is a document which does not even suggest any reduction in the amount of oil. The entire text of the document is as follows:

"Processes of separation have been devised which depend upon the circumstances that under certain conditions some of the particles of a finely divided mixture rise or float in a liquid menstruum, while others sink therein.

"Among artificial conditions for bringing about such a separation is mixing a pulp of the finely divided material with an immiscible liquid such as tar or oil, soap or the like, either alone or in conjunction with other substances such as alkalies, acids, air or gas; or generating a gas in the pulp electrolytically or otherwise.

"By the present invention, such processes are improved by conducting them wholly or in part under a reduced pressure. For instance, a vacuum or partial vacuum may be maintained in the separating vessel or chamber.

"In one form of apparatus suitable for this invention the flow of the liquid used in the operation is directed in such a manner as to produce or assist in producing the reduced pressure; for instance, the waste water or tailings of the process may be caused to fall in a closed conduit or to operate a suitable pump."

The complete specification following this provisional specification was not filed until May 10, 1905. This document contains the first suggestion, and this a very vague one, of any reduction in the amount of oil used. This statement is as follows:

"By the present invention all such [prior] processes are improved, more particularly in the respect that a smaller proportion of the added substance, such as oil or acid, may be used, by conducting them wholly or in part under a reduced pressure."

This document, dated and filed May 10, 1905, was two months later than the invention by Messrs. Sulman, Picard, and Ballot of the froth-flotation process.

Thus the mining public will understand why after this British Elmore vacuum patent and the still later corresponding United States patent (application filed July 10, 1905) had been set up in the answer in the Butte & Superior suit as alleged anticipations, they were stricken from the answer and abandoned at the opening of the trial when I called attention to these controlling dates which demonstrated that they could not by an possibility be treated as anticipations.

The practice of the British Patent Office, with which I am quite familiar, provides that provisional specifications must be preserved in absolute secrecy until they have been followed by the filing of a complete specification and that complete specification has been examined and the application has been allowed or passed to issue. This allowance occurred as to the British Elmore vacuum application on October 16, 1905. When this stage is reached, and the patent is about to issue, both provisional and complete specifications are made public to give an opportunity for opposition prior to the issuance of the patent, and two months are permitted for that filing of such opposition. This is what occurred in the instance cited by Mr. Norris, and his ignorance of the practice led him to make the erroneous statement which he sets forth at large in the article referred to. In a case where the provisional specification is not followed by a complete specification and the application thereby becomes abandoned, the provisional specification remains forever secret unless voluntarily published by the applicant.

The usual purpose of an opposition is to prevent a second patent issuing for the same invention that has been already patented. It is a survival of the old practice of the British Patent Office when no searches were made, and it then provided the only protection to the public against two patents for the same invention. It is still continued as an additional safeguard notwithstanding the fact that searches are now made.

Mr. Norris says that as a result of an opposition filed

against his application by Minerals Separation "it was decided in the British Patent Office that the Norris basic patent did not infringe the Minerals Separation patent." This is wholly wrong. No such question was, or could have been decided. Every inventor who makes an improvement upon another patent is entitled to a patent for his improvement, and that right cannot be taken from him, by opposition or otherwise. He may obtain a patent for his improvement if it has not been previously patented, but his improvement will be absolutely subject to the basic or master patent so long as the basic or master patent is in existence. This is fundamental patent law.

HENRY D. WILLIAMS.

New York, April 5.

[Mr. Williams is chief counsel for the Minerals Separation company.—EDITOR.]

Conditions in Mexico

The Editor:

Sir—Since returning to Mexico I have tried to resume mining, but after shipping about 20 cars of ore, I had to give it up. Between the railroad, the smelter, and the Government, 60% of the gross value of the ore was taken; the remaining 40% just paid expenses. Then came the decree that all gold, even in ores shipped, had to be reimported within 10 days, which was an impossibility, as we could not get returns from the smelter in less than 40 days. This decree was simply a reprisal upon the United States for having issued an embargo on the exportation of coin. Although Mexico tries to make out that foreign coin is unnecessary, nevertheless, if it were not for the American money in circulation in the country, business would be seriously hampered; and if the Government did not accept U. S. gold coin for dues, it would have to go out of business. The Mexicans do not take into account that the United States can effect such an embargo, and that, as a military move, it was necessary, and not intended as an unfriendly act. Mexico cannot secure even a pin, unless it is imported, since it has no domestic manufactories, and an embargo of the kind under discussion could have but one result, and that would be detrimental to that country. However, it is claimed it will tend to force the nationals to develop their own resources, and they fail to take into account that it requires time and money to do that.

A short time ago I saw an article in the 'Boletin Minero', an official organ, in which one of the editors took issue with a London paper, which criticized the petroleum tax. He says: "Foreigners and foreign capital are welcome, but they are not necessary." Working on this principle, the main object seems to be to make it so hard for the foreigner, by taxes and discriminations, that he will have to get out, and at a sacrifice. Recently a Mexican engineer told me he had gone to Mexico City for a foreign company to try to arrange for importing funds to meet their daily needs. After threshing the matter over, all he could obtain was the permission to transport bullion from the West Coast, via Laredo, to Mexico City. When the Department Official was told that it could not be done safely, and that the mine would have to close, the reply was: "We do not care; they will continue work, or we will take over the mine and work it for the Government." This is the animus one constantly finds. Duties, in many cases, are 100% of the original cost; and to this is added a like amount of 'infalsificable' bills; not as an extra duty, but as an easy way to retire that obligation, as was pointed out editorially in the MINING AND SCIENTIFIC PRESS.

The Government recently has promulgated an Indemnity Law. It looks all right; but it simply begs the question. The main requisite demanded of all claimants is that they present receipts. Outside of the railroads, this will mean that there will be no foreign claims to settle. I do not need to explain. The officer who, upon turning his regiment of cavalry into your orchard, horses and all, told you to go to .... when you protested, would be likely to give you a receipt for damages! You noted in your paper last autumn that denouncements for mining claims, in Mexico, were suspended until the new law should be promulgated on January 1, 1918. That law is not promulgated yet, and the right to denounce claims is denied to the foreigner; but any Mexican can denounce at any time. A mining agent told me that his orders were to refuse the denouncements made by foreigners until the *reglamentos* of the new law could be put into effect, but to accept all denouncements made by Mexicans. The foreigner cannot buy any property at all in the country, except by permission from the Government, which, at times, can be obtained by renouncing all his treaty rights. Within 50 kilometres of the coast no foreigner can acquire title to any property.

The country was threatened with a new deluge of paper money, but the opposition has been so persistent and open that the Government has deferred the date of issue, and is now trying to float a $100,000,000 loan within its own boundaries, in order to establish the single bank of issue, but the general management of all departments, both Federal and State, has been considered to be so corrupt that this scheme is fizzling also. It is doubtful if $1,000,000 in real money can be raised in the whole country. The 'bilimbique' incident is too fresh in the public mind; and while there is no co-ordinated public opinion, nor the courage of conviction, still the impassive opposition cannot be combatted by the Government, and all internal financial projects are sure to fail.

One would think that the spirit of the people would be to encourage industry, regardless of the source of the capital, but it is not. Here is an instance: The Government has decreed that all water taken from the rivers for irrigation, regardless of the method, shall pay a tax of 5c. per 1000 cubic metres. This ordinarily works out at about 6c. per acre. On one farm operating under a pumping concession the owner, who is an American, was not charged for the water actually used, but on the total amount that could be demanded under the concession. In his case, the tax for this year amounts to 35c. per

acre for irrigation. That is what he paid. Such a thing would not have happened to a Mexican.

There seems to be little hope for the present generation, and it will have to get along as best it can. Mexico's only salvation lies in education. It needs schools, and only common schools at that. To this schooling must be added a thorough training in the Ten Commandments as a bit of necessary fundamental law. Without such moral and ethical training there can be no national advancement, and no civilization. If the Government will drop its reform program and give the country absolute commercial, industrial, and intellectual freedom, if it will establish schools and equitable courts of justice, and encourage rather than impede the national progress, confidence will become re-established at home and abroad, credit will become available, and prosperity will return.

SEGADOR.

Torreon, Mexico, March 18.

A Suggestion

The Editor:

Sir—I wish to propose, in all seriousness, a new type of specialist. Not that he would be absolutely and wholly new, nor even that he is not already in existence, but that he needs emphasis. The specialist to whom I refer is the social consultant.

The social consultant would be employed by a single mining company, or preferably, by a group of mining companies. His function would be to furnish expert advice concerning so-called labor problems.

There is need for such advice, because the manager, in general, is not skilled in these problems. As mechanical engineer, metallurgist, geologist, he may be expert. But he cannot be an expert in everything. As engineer of sociology he must, and does, admit his lack of qualifications.

There is need for such advice because the labor situation is critical. The fire of revolution has been set. Perhaps it will burn slowly and genially, as we pray it may. Perhaps it will burn fiercely—a terrible conflagration. Either way, the laborer has a new power; the old days are gone and the old methods obsolete. New days have come. New methods are demanded. If the manager is to find them, he must have expert advice.

He must have expert advice concerning the causes of discontent and disloyalty, concerning the problem of union recognition, the problem of industrial (and non-industrial) sickness, the problem of housing and the problem of corrupt administration in labor organizations, and a dozen other matters. Not amateurish, half-hearted, haphazard, or prejudiced advice, but the shrewdest, most sagacious, best considered advice that can be found.

The man to give this advice must, I grant, be exceptional. He must be pre-eminently tolerant, sympathetic, and fair; he must be able to inspire confidence and by that confidence to bind men to his cause; he must be above reproach; he must be a student and a philosopher; he must be a business man and scholarly—a big man all round.

Such a man would serve, not capital, nor labor, but humanity; for he would act on the only enduring basis of conduct—that of justice.

Men who could do this work can be found. They exist, but they are busy at other tasks. Perhaps they would want a high reward to lay down those tasks for this one. The mining industry would do well to get their services. It could afford to pay a high price.

AUGUSTUS LOCKE.

San Francisco, April 5.

The Minerals Administration Bill

The Editor:

Sir—Permit me to thank you, and through you the author, for the very understanding and constructive contribution on the Minerals Administration Bill by George Warren Tower Jr. to a recent issue of your paper. Mr. Tower has evidently given much thought to the subject.

The details of the bill will doubtless be modified in the House Committee and receive still further modification in passage through the House itself and the Senate, but the essential ideas it is hoped can be successfully carried through both houses of Congress. The great need is the granting of sufficient power and resources to some man eminent in the mineral industry, located in Washington and assisted by an able body of mining men. Second only to the prime duty of all of us to help win the War, this mineral administration's principal duty would be the direction of inevitable governmental interference during the war toward the fostering, rather than the suppression, of our industry. Our committee in its original draft of the bill endeavored to gain this protection for all the mineral industries, but the principal metal industries, such as those of iron, steel, copper, lead, and zinc, have not as yet been sufficiently aroused to the ever-increasing disadvantages under which they will be compelled to work while the War continues. Their indifference, and in some cases opposition, where support is essential, has necessitated limiting the bill now before Congress to the minor minerals.

In the case of such minerals as pyrite, manganese, and chromite, the necessity for immediate fostering is so obvious to the producers that (granting we can get our profession aroused to enthusiastic support) there is excellent chance that this modified bill can be passed in some practical form. This done, and a satisfactory minerals administrator appointed, it is hoped that the principal industries will come to realize the advantages this administration might be made to have for them and see to it that they are included in the protection thus afforded before too great damage is done.

The War has already compelled drastic steps in governmental control over such essentials of industry as labor, transportation, and supplies (particularly imports), and practically complete governmental control will be upon us at no very distant date if the war experi-

ence of our Allies is any guide. In the labor situation we already have millions of men being drawn into military service, while other millions are being employed by 'cost plus 10%' and 'rush regardless of cost' Government contracts that have absolute command of the labor market as against normal industries. Again, the Government's recent large-scale labor-housing undertaking will shift labor centres of gravity away from industries failing to receive proper consideration. The embargo on transportation, both of our supplies and our products, is requiring ever more careful attention and supervision. Imports either already are or shortly will be limited to the barest necessaries and the mineral industry must be prepared in advance either to furnish its own needs or to see to it that its indispensable imports are maintained.

The power back of these forces is indicated by the size of the loans the Government is being obliged to call for. With billions of dollars being raised every few months for expenses wholly abnormal and solely for the destructive purposes of war, is it not futile to expect that ordinary conditions will prevail in the mineral or any other industry? Even the largest and most highly organized of our mineral industries cannot of themselves expect to properly meet these forces. Patriotism and self-interest will have to combine to unite large and small in shaping themselves to these war compulsions and to seeing to it that there is an adequate mineral administration in Washington with which they can co-ordinate and through which they can as far as possible turn these compulsions to constructive rather than destructive action on our industry.

WILLIAM YOUNG WESTERVELT,
Chairman War Minerals Committee.

New York, April 8.

War Minerals

The Editor:

Sir—In connection with the Government's tentative proposal to assume control of the production of needed war metals, would it not tend greatly to speed up the discovery and production of such deposits if this new Bureau of Metals would, through the publications of the country, officially appoint as a committee of one, every mining engineer, prospector, miner, or other engaged in the mining business, to bring to the attention of this Bureau all deposits of molybdenum, chrome, etc., that they may find? I take it that the needs of the Government for these essential metals will supersede the customary financial question of a profit from their production, and that it is imperative that this urgently needed production be obtained, even though it entails a pecuniary loss in the operation to the Government. If this assumption be correct, it will at once bring to the mind of many mining men the recollection of one or more deposits of some of these metals that ordinarily will not pay to operate, but which can produce a certain amount of needed metal for war purposes.

The number of such deposits, while not legion, is large, and their combined production would materially increase the spare stocks of metal on hand and go far toward alleviating the present distressing stringency in some of them.

F. H. MITCHELL.

San Francisco, March 28.

[Any mining engineer, prospector, or miner that knows of a deposit likely to yield any metal or mineral required for the War should communicate with the State Mineralogist or with Mr. W. Y. Westervelt, chairman of the War Minerals Committee, at Washington. We discuss this subject in the editorial department.—EDITOR.]

Flotation Royalties

In its report for 1917, the American Zinc, Lead & Smelting Co. says: "It will be noted from the profit and loss statement that a settlement was effected with the Minerals Separation North American Corporation for alleged infringement of their flotation patents at your Tennessee and Missouri operations by paying the sum of $250,000 and agreeing to become a licensee of the Minerals Separation Company. The technical staff of your company developed the process which is now being successfully used in treating Mascot ores after tests by the Minerals Separation Company had indicated that their process as then conducted would not give commercially satisfactory results, but the Supreme Court decision of December 1916, in their favor in the case of the Minerals Separation Company v. Hyde, was so broad that in spite of the fact that it was only the improvements made by your employees which made the use of the flotation process feasible on Mascot ores, your counsel advised that the operation probably infringed their basic patents and recommended a settlement, which was arranged."

LUMBER PRODUCTION in the United States in 1917 was 39,200,000,000 ft., a decrease of 2% compared with the cut of 1916. This is an estimate made by the Forest Service based on incomplete reports received up to February 26, 1918. Oregon led with a cut of 3,208,000,000 ft., followed by Louisiana with 2,726,605,000 ft.; Mississippi with 1,204,788,000 ft., California with 1,174,326,000 ft., and Texas with 1,009,227,000 feet.

EARTH-SLIDES may be stopped by sub-drainage, according to George L. Dillman. He says "there never has been a slide that could not be cured in this way." Slides are due primarily to water-pressure. Relief of the pressure by sub-drainage ends the difficulty. The slides at Panama might have been remedied by early application of this well-known method.

ICHTHYOL has been found in the oil from the wells on the Warm Springs dome in the Big Horn basin, Wyoming. The oil contains 3 lb. per barrel, and the ichthyol, after refining, is worth $4 per pound. The only other oilfields in the world that hitherto have reported this valuable drug are those of Rumania.

Flotation of Semi-Oxidized Silver Ore

By E. J. ATCKISON

*About a year ago a pronounced effort was made to adapt the process of flotation to Mexican silver ores. This was caused by the high price of cyanide. Since cyanide can now be obtained at a more moderate figure the new process has become less inviting. Few of the companies met with much success. The Santa Gertrudis, Real del Monte, and Amparo companies have no doubt done the most work on flotation. According to the report of the Department of Mines of Mexico the extraction at both the Real del Monte and the Santa Gertrudis was about 50% of the total gold and silver, but I was informed later by representatives of these two companies that an extraction of about 85% was expected after making a few minor changes in the flow-sheets.

The Amparo Mining Co., at Etzatlan, Mexico, in the preliminary work used one K & K machine (type 2612) as a 'rougher,' and a Callow cell as a 'cleaner.' The Callow cell was constructed of wood by Mexican carpenters, while the K & K was a factory-made machine. A battery of 10 stamps crushed the ore to 20-mesh. The pulp then passed to a Dorr classifier, the overflow going to the K & K, and the coarse product to a Krupp tube-mill. The tube-mill discharge was returned to the classifier, so that the feed to the flotation-mill consisted of 90% minus 150-mesh material.

Sodium sulphide at the rate of one kilogramme per ton was used for sulphidizing. A number of different oils and oil-mixtures was tried; G. N. S. No. 5 and G. N. S. No. 22 gave the best recovery. The practice was to add the sodium sulphide and the collecting-oil direct to the tube-mill, and the pine-oil to the classifier overflow. A rough concentrate was taken from the K & K machine and re-cleaned in the Callow cell. The rough concentrate averaged three kilogrammes of silver per ton. The tailing from the K & K was sent to two settling-tanks, where a small amount of lime was added, the clear water being pumped back to the battery. The pulp varied between 8 and 15% solid. On account of the water necessary in the battery it was impossible to keep a dense pulp without thickening. In this test 748 metric tons of ore was treated, giving an average recovery of 72% of the silver and 85% of the gold. The heading assayed 376 grammes silver and 8 gm. gold. Cyaniding the flotation tailing was tried, and it gave an extraction of about 50% of the silver, or a total of 86% of the silver and over 90% of the gold. This was about equal to the results obtained in the cyanide plant at that time, but it took as much cyanide to extract the 50 odd grammes of silver in the flotation tailing as it did to extract 320 gm. of silver in the cyanide plant. It was also noticed that the solution fouled quickly when treating the oily tailing.

The concentrate from the Callow cell averaged 15 kg. silver, 380 gm. gold, 16% lead, 9% zinc, 5% manganese, 20% iron, 4% lime, and 16% silica. A great deal of difficulty was experienced in handling the concentrate. No filter was available, but the concentrate was settled in the four 'pilas' (3 by 4 by 7 ft.). When a 'pila' showed concentrate within four inches of the top, the flow was diverted from it, the concentrate was allowed to settle for a few hours, and then sacked.

Following this test an effort was made to thicken the pulp in a Dorr thickener before flotation. The pine-oil was added direct to the K & K machine, but the flow-sheet otherwise remained the same as in the previous test. So as to be able to get a thickened pulp, 8 kg. of lime per ton of ore was added in the battery-bin. The result was disastrous. A voluminous froth that carried a very small amount of concentrate appeared on the flotation machines.

The concentrate coming from the cleaner-cells assayed only about 3 kg. of silver, the recovery being 50% of the silver and 55% of the gold. The lime was poorly burnt, thus accounting for the amount used. As soon as the addition of lime was stopped the machines started to produce the proper froth. An analysis of the lime was made to see if the cause of the trouble could be detected. As stated before, previous to this time it was the custom to add lime to the flotation tailing for settlement and pump back the clear water. The return-water carried about 0.25 kg. of lime (CaO) per ton, and for 12 hours each day only the return-water was used in the battery.

	Analyses of lime	
	%	%
SiO_2	29.5	29.6
Fe_2O_3	5.4	10.7
Al_2O_3	3.5	3.2
CaO	41.3	38.5
MgO	1.8	1.5
Mn	less than 1%	
CO_2	considerable amount	

The froth produced at this time reminded me of that obtained when experimenting with some lead-carbonate ores. These apparently sulphidized nicely, but a recovery of about 50% was all that could be obtained. In almost every case where the recovery was low a voluminous froth appeared. The conclusions reached after the first series of tests were that:

1. Sulphidizing was indispensable with the oxidized ores.

*This work was performed under the supervision of J. H. Howard, general manager, and William Howard, assistant general manager for the Amparo Mining Company.

2. Fine grinding was essential to free the mineral.

3. Two machines in series were necessary, in order to increase the recovery.

4. The density of the pulp must be 4 or 5 : 1.

5. Raw lime added ahead of flotation was detrimental, but enough lime to promote settling could be obtained by adding it to the flotation tailing and then pumping back the clear overflow.

While waiting to install another K & K machine and re-arrange the flow-sheet a series of experiments was made in a Janney testing machine. It was found early in the work that a good extraction could be obtained by adding sulphuric acid to the pulp. However, the amount required, namely, (40 kg. per ton) was prohibitive. Gasoline was tried, and was found to be as good a flotative assistant in this case as acid. How the gasoline works is doubtful. The idea was that the gasoline cleaned the oxidized mineral and allowed the sodium sulphide to act upon it.

Assuming this to be the case, gasoline was added to the pulp in the proportion of 4 : 1 first and was then agitated two minutes in the Janney machine before adding the sulphide of sodium and the oil. Too much emphasis cannot be placed on the use of gasoline in flotation. With lead, zinc, and copper, and with graphite, the results in most cases were as good as when acid was added.

One thing is noticeable in these, as well as in all the other tests, namely, that the gold floats more readily than the silver. These experiments were conducted under as nearly the same conditions as possible and each experiment represents the average of three parallel tests.

The final test was divided into two periods. During period A 310 tons was treated, and during period B 204 tons. The flow-sheet is shown in the accompanying diagram. While treating the last 514 tons more oxidized ore than usual was drawn from the upper levels of the mine. This was much better from an experimental point of view, for the sulphides float readily. The Wilfley table acted as a pilot.

Period A

	Heading gm.	Tailing gm.	Recovery %
Silver	334	53	84.1
Gold	5.6	0.6	89.3
Total	...	...	85.9

Oil used: G. N. S., No. 5, 0.1 kg. per ton, plus G. N. S., No. 22, 0.3 kg. per ton.

Sodium sulphide: 0.8 kg. per ton.

Pulp: dilution, 18% solid; fineness, 90% – 200 mesh.

Assay of concentrate: silver, 12.035 kg.; gold, 240 gm.

Wilfley table concentrate: 926 kg., assaying silver 776 gm. per ton; gold 14 gm. per ton.

Tonnage: 40 tons per 24 hours.

During period A the entire load was thrown on one K & K machine for three days. This brought the recovery down somewhat. The froth from the No. 1 K & K machine assayed about 6 kg. of silver per ton, while the froth from No. 2 was a trifle over one kilogramme.

Period B

	Heading gm.	Tailing gm.	Recovery %
Silver	320	44	86.2
Gold	6	0.5	91.6
Total	...	...	88.1

Oil used: G. N. S., No. 5, 0.1 kg. per ton; G. N. S., No. 22, 0.25 kg.

Sodium sulphide: 0.75 kg. per ton.

Pulp: same as in test A.

Assay of concentrate: silver, 12.671 kg.; gold, 232 gm.

Wilfley table concentrate: 806 kg., assaying silver 859 gm. per ton; gold 18 gm. per ton.

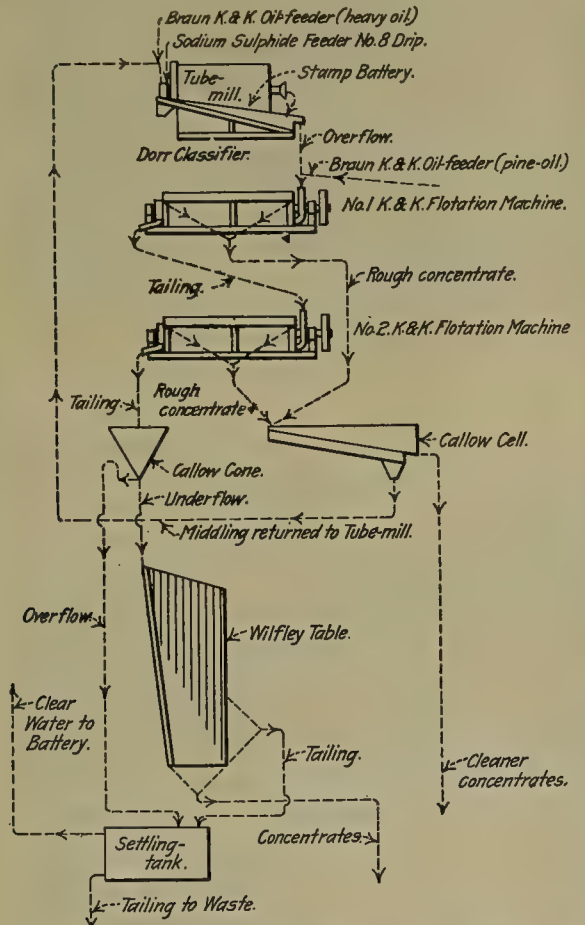
Experiments in a Janney Machine

Test No.	Heading Silver gm.	Heading Gold gm.	G. N. S. No. 5 gm. per metric ton	G. N. S. No. 22 gm. per metric ton	Na_2S gm. per metric ton	Gasoline gm. per metric ton	Recovery Silver %	Recovery Gold %	Remarks
1	424	8	100	200	....	....	41	75	1 litre SO_2 added
2	424	8	50	100	....	....	59	76	36 kg. H_2SO_4 per ton
3	424	8	100	100	400	....	30	30	2 litre SO_2 solution
4	424	8	100	100	400	....	83	93	36 kg. H_2SO_4 per ton
5	424	8	100	200	1000	....	80	87	
6	424	8	100	200	400	400	84	94	
7	413	7	50	50	500	500	84	92	
8	210	3	50	200	500	400	85	90	Slime, – 200 mesh
9	300	8	50	200	500	400	75	87	Sand, – 100 mesh
10	255	5	100	200	500	400	85	96	
11	255	5	100	200	500	....	78	90	
12	240	4	50	200	.....	400	75	87	1 kg. NaOH per ton
13	376	6	100	200	500	400	75	90	Na_2S and gasoline added after the oil
14	340	8	100	...	500	....	87	90	½ kg. Calif. crude oil per ton

Cost of Flotation v. Cyanidation. To simplify the calculations, let us consider the recovery the same by flotation as by cyanidation, although the extraction by cyanide is a trifle better. The cost of freight and treatment on one ton of concentrate is $19.22. From this would be deducted the premium on the lead, which would be about $5. The cyanide plant now produces one ton of concentrate per 24 hours from the sand and slime tables. A 300-ton all-flotation plant would have an output of about 7 tons of concentrate per 24 hours. Flotation costs in the mill would amount to 95c. per ton, which

includes the cost of fine grinding, chemicals, labor, water, repairs, and minor items. Another charge of $2.46 per ton covers the cost of marketing the concentrate, taxes, and a loss of 5% of the silver and gold, as the smelter pays for only 95% of the assay-value. This makes a total cost of $3.41 per ton.

Cyanidation, when the value of cyanide at the works is 75c. per kilogramme (34.1c. per lb.), costs $3.92 per ton, which includes the cost of marketing the bullion and other expenses. This leaves 51c. per ton in favor of flotation. Cyanide at a normal price of 35c. per kg., with an extraction 1% higher by cyanidation, would more than make up the difference. There is also the interest and depreciation on the flotation plant to deduct. To



FLOW-SHEET FOR FLOTATION OF SEMI-OXIDIZED SILVER ORE

make the change from the present plant to an all-flotation mill would cost about $40,000, including the necessary re-grinding machinery.

The success of flotation seems to be determined by the treatment of the concentrate. If a supply of Mexican crude oil could be obtained at a reasonable figure, it would be a simple matter to install a small roasting-furnace, and, after roasting the concentrate, to melt it in a reverberatory furnace. The base lead bullion could then be cupelled, producing fine gold and silver bullion, and litharge. A market for the litharge would have to be found. The consumption of cyanide on the raw ore amounts to three or four times the silver content. If the heading averages 300 gm. silver the cyanide would amount to about one kilogramme per ton. This ratio of cyanide to silver holds true in the flotation concentrate. The experiments showed that a 12-kg. concentrate would require about 45 kg. cyanide. It was noticed in cyaniding the concentrate that the gold went into solution much more readily than the silver. The heavy collecting-oils retard the cyanidation materially. A gasoline wash before cyaniding is quite effective. Since it required practically the same amount of cyanide to treat the flotation concentrate as it did to cyanide the ore, the question of cyaniding the flotation concentrate puts one where he was in the beginning as regards the cyanide.

Tests Showing Effect of Oil

Oil	NaCN 98% gm.	Time hr.	Mesh	Recovery Silver %	Recovery Gold %
None	0.2	70	−100	84	90
Pine-oil	0.2	"	"	79	85
Pine-tar	0.2	"	"	76	84
Coal-tar	0.2	"	"	72	82
Crude oil	0.2	"	"	66	69
Creosote	0.2	"	"	78	75
Pine-oil	0.2	118	"	87	92
Pine-oil	0.3	70	−150	87	89
Pine-tar	0.3	72	−200	86	87

The heading assayed silver 326 gm. and gold 7 gm. In all of the experiments 100 gm. of ore was taken, 300 cc. of water, and a small amount of CaO. The oil used was equivalent to one kilogramme per ton. The cyanide consumption was practically the same in all the tests. The ore, oil, and water were mixed for five minutes in the Janney testing-machine before the cyanide was added.

LITHOGRAPHIC STONE is being actively developed at Brandenburg, Kentucky, according to the U. S. Geological Survey. The foreign supply having been shut off it is important to utilize such domestic resources as may be available. Even in a good quarry of lithographic stone the high-grade blocks obtained represent but a small fraction of the total material broken, but the culls can be used by crushing for concrete construction and by grinding for agricultural purposes, a demand that is steadily growing. Lithographic stone is very uniform in quality, containing less than 4% silica, rarely as much as 0.5% alumina, and from 44 to 52% lime (CaO). Being non-crystalline it grinds readily, and is a desirable material to use in making a 'mix' for cement manufacture.

CONCRETE depends for its strength upon securing the highest possible density. With a given aggregate and the same quantity of cement the strength of the concrete reaches its maximum with the smallest quantity of water that can be used to produce a plastic mix. Any increase in the amount of water is accompanied by a rapid decrease in the strength of the concrete.

Sacramento Hill Disseminated Copper Deposit—II

By COURTENAY DE KALB

In the office of the geological department of the Copper Queen mines the records of the drill-sampling of the disseminated deposit in Sacramento hill are reduced to objective representation by means of two separate and unlike models. One of these consists of wrought-iron posts ⅜ in. diameter, each painted in shades indicating an assay-value lying between narrow limits of a fixed maximum and minimum. The posts are screwed into holes in a ¼-in. iron plate spaced so that the diameters of the posts and the distances between them are in the true proportions to the diameters and distances apart of the actual holes. The tops of the posts above the base correctly reproduce the topography. Sheet-metal cut into proper strips is used to denote the ramifications of the underground workings. Thus at a glance the position and size of the orebody are visible, as also the variations in richness and outline. Another model, however, which is less easy to keep up to date, presents the leading features even more vividly. This is painted in transparent colors on automobile wind-shield glass plates set one inch apart, the surface being shown on each plate. The model is sustained in an open-work frame, so that it is completely transparent and can be viewed from every side. It is unlike most glass mine-models; not only is the orebody seen with the details in their proper relations, but it appears like a luminous cloud suspended in a clear medium, so that its every feature may be examined.

After drilling had proceeded for a short time what seemed like erratic variations in the depth to the ore provoked uneasiness regarding possible difficulties of mining the deposit. This was before the peculiar form of the orebody had been determined. As data accumulated the outlines on the model grew into a well-defined figure. The first impression that it produces is that of outstretched wings above a bulky body having a somewhat rounded shape. J. B. Tenney, the geologist in charge, compared it to a mass that had been eroded into a valley. The accompanying cross-section gives only part of the effect obtained when looking at the model; the trough is seen, but the rim on the left is thinner than the average. What the section does show, however, is the vagaries of oxidation; a re-entrant mass near the top projects under a shelf of ore assaying 1.75 to 3.5% copper; below this is a large mass of oxidized waste, with the 1.75 to 3.5% ore above, and a considerable thickness of 1.3 to 1.75% ore directly underneath, the high-grade (above 3.5%) persisting as the core of the main volume of ore, and being surrounded by leaner material on every side. Those who insist upon playing the porphyry-copper game according to Hoyle will find trouble with this array of exceptions. As a matter of fact the experienced geologist has learned that the more new ore deposits that are developed the more new principles are discovered.

GEOLOGY. The Sacramento hill deposit has been full of surprises and unique relationships. For one thing, it is not a secondarily enriched orebody; neither is it primary. In appearance the ore bears a general resemblance to the ordinary disseminated porphyry ore enriched by leaching and re-deposition; the copper is present as chalcocite, and largely in the form of the so-called sooty chalcocite, held in a highly sericitized grayish gangue. It proves, however, to be a zone of primary mineralization, altered in place by sulphate waters with very little addition of copper from above.

Returning to the structure of the orebody, Sacramento hill shows a series of east-west fractures. These are approximately parallel to the line of weakness originally developed by the Dividend fault. Otherwise they have nothing to do with that fault, except that they are secondary to it and perhaps were induced by it. They dip in the same direction, that is, to the south. The axis of the East and West orebodies conforms almost exactly to the trend of the Dividend fault. The best defined of these induced fractures in the granite-porphyry stock forms a well-marked foot-wall for the West orebody. It is the only wall that has been discovered, and in the underground workings it is seen to be markedly slickensided; that it is a pre-mineral movement is proved by the circumstance that it constitutes a limiting plane for the ore. Some of the other faults in the hill are post-Cretaceous, probably responding to the disturbance due to movements still taking place on the Dividend fault. This great fracture, supposedly originating in later Carboniferous time, or in the early Permian, although invaded by the granite-porphyry that was responsible for the mineralization in the Copper Queen property, has not ceased its movement; a normal displacement is proceeding at such a rate as to render it impossible to maintain open drifts in its neighborhood; as a result of the continuance of the faulting movement they close within a year. This movement is increased by stoping. In common with the orebodies of the entire Warren district the longer central axis of the Sacramento Hill masses bears S. 80° E. and inclines south-east. The West orebody 'bottoms' at a depth of 400 ft., and the East orebody at 1100 ft., within a longitudinal distance of 2000 ft. Thus the 'valley' in the orebody would drain in that direction, and its position is further conformable to the plane of



BIG BLAST IN BRECCIA ABOVE THE SACRAMENTO HILL OREBODY

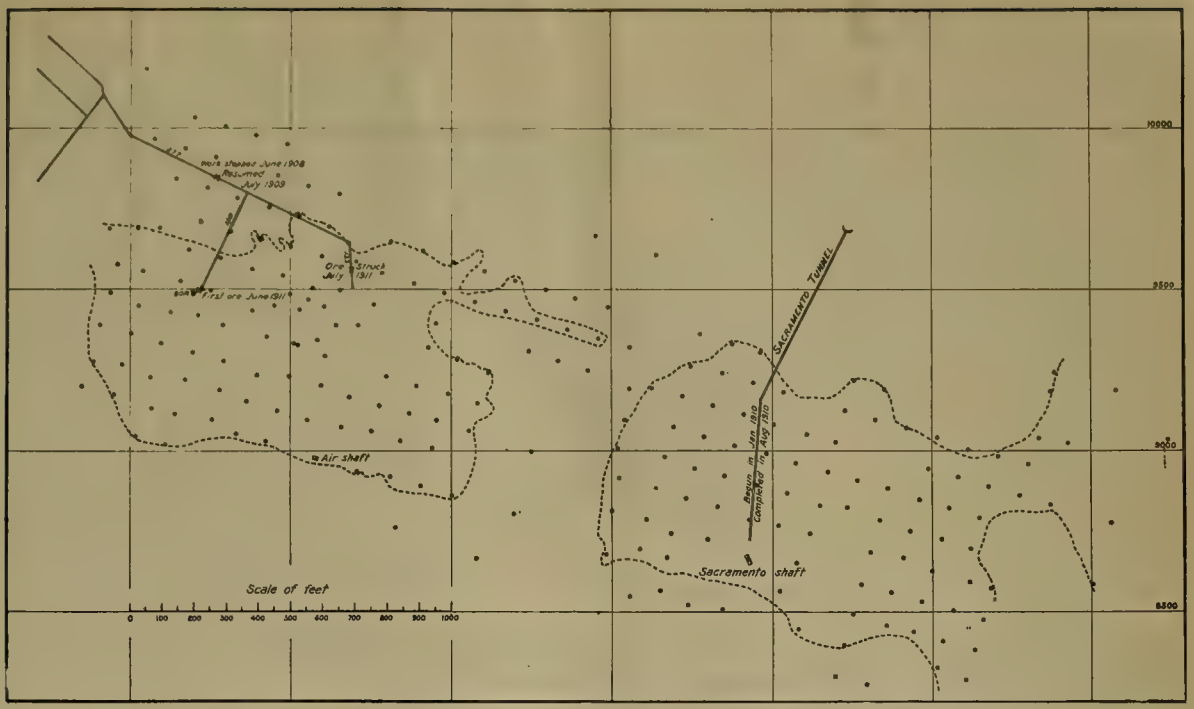


SACRAMENTO HILL, READY FOR THE STEAM-SHOVEL ON MACHINE-SHOP BENCH

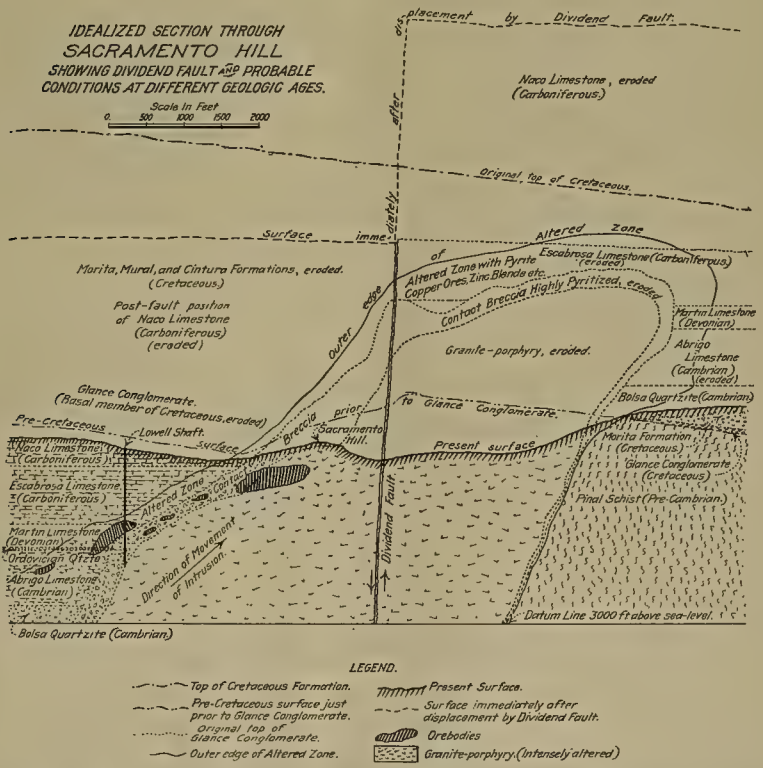
the foot-wall, which limits the limestone replacement orebodies on the W.S.W. side. Despite the corrosion from oxidation along the central axis, a large part of the valley-wall on the northern side is composed of altered primary ore revealing but little secondary enrichment, assaying above 3% copper, while the wedge-like mass forming the south-west slope is generally leaner than 1.3%. It must also be observed that the Sacramento Hill orebody lies in the porphyry on the side next to the limestones, which is again in conformity with the rule of the district, for the ores lie in the younger rocks on the hanging-wall side, that is, the south-southwest side, of the Dividend fault. The Pinal schist, the Bolsa quartzite, the Abrigo, Martin, Escabrosa, and Naco formations, had been faulted up on the north side, and were worn away during the pre-Cretaceous erosion-period. The granite-porphyry stock outcrops much farther on that side of the Dividend fault than it does on the south, but the northern portion is destitute of ore. The porphyry on the north side, however, is thoroughly mineralized with sericite and pyrite, corresponding to the porphyry below the ore on the south side. Any ore which may have existed would have been in the Paleozoic formations, which have been eroded since. This localization is significant; it is one of the characteristics that definitely ties the Sacramento Hill deposit to the same genetic influences as those responsible for the rich accumulations that have marked the history of Bisbee.

An interesting peculiarity of the granite-porphyry stock is that it invaded the plane of weakness offered by the Dividend fault but did not spread out and occupy the fault-plane in the form of a dike; it advanced as a mass 5000 ft. long in the direction of the Dividend fault and 4500 ft. wide at right angles, that is, in a northerly direction. It is not a stock of ideal shape, since it is not of rounded horizontal section; it is exceedingly irregular in outline, particularly in its extension toward the north and north-east. It did not enter in a molten condition, nor did it stope its way upward; it was forced up as a plastic mass, and brought with it a marginal load of debris, composed of mixed fragments from every formation traversed, including rounded 'bombs' of the porphyry itself. This fringe is characteristic of the intrusion, and resembles the 'drag' often produced in faulting; locally it is called the 'breccia zone'. The width of this breccia varies from 50 to 1000 ft., and it not only formed a border to the stock, but covered its advancing crown. After erosion of the superincumbent rocks it remained as a capping over Sacramento hill, and it was this that gave to it the peculiar appearance previously mentioned. Alteration has affected it differently from the stock that it enveloped.

Three distinct types of ore are observed at Bisbee, (1) the porphyry ore in the altered stock, (2) contact or primary replacements in the breccia, and (3) normal replacements in the limestone, which extend in places to a distance of 3000 ft. from the porphyry. Mineralization of the granite-porphyry took place after consolidation of the rock, and there is not much evidence of pneumatolysis. The minerals formed at that period are those characteristic of moderate temperatures; even the scanty garnet is of the variety andradite, which develops at a low temperature. There was an original pneumatolytic action contemporaneous with the intrusion, producing magnetite, zinc-blende, and pyrite; and a second at the end of the intrusion, bringing in silica and pyrite, but this was confined to an outlying area, and its effect upon the rocks was small, owing to the low temperature. The outcrop of breccia on Sacramento hill had been silicified; it weathered into dark blocky masses, resistant to erosion. The ground-water toward the end of the pre-Cretaceous erosion-period probably was charged with sulphates of iron and copper and also contained considerable free acid, consequent upon the erosion reaching the contact zone between the porphyry and the Paleozoic rocks to the north of the fault. The erosion of the up-thrown block on the north side apparently kept pace with the oxidation, so that when the contact zone was reached, toward the end of Paleozoic time, the seepage waters took up large amounts of free acid and sulphates of iron and copper. As the north side was high ground, most of this drainage flowed into the depressed area to the south, sank into the rocks, and altered the ores that have now been developed. This probably accounts largely for the fact that the effects of the pre-Cretaceous oxidation and enrichment were so much greater than those of the latest uplift, despite the longer period of this late movement. During the present erosion-period, except possibly at the top of Sacramento hill, no masses of contact material have been exposed on which surface waters could act. Therefore they have been free from acid. The porphyry and the contact-zones have been completely sericitized, but the sericitization preceded the final metallization, while the introduction of the metals in the porphyry represented the expiring phase of primary mineralization in the district. Pyrite, however, was deposited both before and during the period of sericitization. Below the ore-zone the porphyry is sericitized and highly pyritized, but contains only 0.2 to 0.4% copper. The deposition of the copper appears to have been dependent more upon decrease of pressure than upon chemical reaction. The pyrite is quite free from copper, even when embedded in chalcocite, while the primary copper mineral was almost exclusively deposited as bornite. Outside the porphyry ore the more abundant primary copper mineral is chalcopyrite, usually intergrown with bornite, but in Sacramento hill chalcopyrite is uncommon, except toward the outer edge of the deposit. The bornite is usually found replacing pyrite, but it also occurs quite independently of the pyrite. As a whole, however, the porphyry ores, now containing the copper almost completely altered to chalcocite, are unique in possessing an extraordinarily high percentage of pyrite. Mill-tests give one ton of concentrate for every 3½ to 4½ tons of ore, and the concentrate contains from 8 to 12% copper and 30% iron. A noteworthy feature of the pyrite is that the crystals are



EAST AND WEST OREBODIES, DRILL-HOLES, AND EARLY EXPLORATORY WORKINGS



RELATION OF GRANITE-PORPHYRY STOCK AND OREBODIES TO DIVIDEND FAULT

invariably fractured, and the bornite fills the interstices and has eaten into the pyrite. The pyrite has undergone no change during the period of secondary alteration, but the primary bornite has been converted into chalcocite by the addition of oxygen and the subtraction of iron and sulphur. In the process of alteration the chalcocite



North-South Section thru Sacramento Hill Porphyry Ore-body showing grades of ore developed.

1-1.3% 1.3-1.75% 1.75-3.5% above 3.5% Oxidation

0 50 100 200 300 400 Feet

takes the bornite cleavage. Some copper has evidently been removed also, and the enrichment has been negligible. The overburden, which consists chiefly of the breccia, contains from 0.1 to 0.2% copper, now existing in oxidized compounds. This apparently denotes the original copper content in that zone. In depth the breccia-zone holds contact-ores of importance, and marked differences in the order of mineralization and alteration are observed. A detailed account of the general geology of the district and of the mineralization and ore-formation outside of Sacramento hill is given in a paper‡ by the geologic staff of the Copper Queen, namely, Y. S. Bonillas, J. B. Tenney, and Leon Feuchère. It is of extreme interest as an exposition of the complex phenomena that have yielded so many varieties of ore derived from a single primary source of metal-bearing solutions.

EXPLOITATION of the West orebody of the Sacramento Hill deposit has now commenced. Tests made in the pilot-mill, erected on the southern end of Sacramento hill, have shown that flotation should afford a recovery of 90% of the copper. The large mill will be erected near the head of the plain that inclines southward from the Mule mountains toward the main line of the El Paso & Southwestern Railway. The plant will treat 3000 tons of ore per diem. Part of the deposit exceeds 4% in copper, and such ore will be shipped to the smelter at Douglas. The general superintendent, Gerald Sherman, has evolved the plan for mining, the detail having been worked out by Lewis E. Foster of Gila, New Mexico. In the beginning it will consist in the removal of successive slices with steam-shovels, to develop gradually into a large open pit with spiral tracks and switch-backs. The deeper part of the orebody may be mined and drawn off below from levels extended from the Holbrook and Sacramento shafts.

The first problem is the removal of the overburden. The amount of this is excessive. For every cubic yard of ore developed to date 2¾ cu. yd. of waste must be stripped, and two-thirds of the total volume will have to be removed before reaching the ore. A large part of it will be dumped in Spray gulch, but some will have to be taken to more distant points. One of the illustrations shows the beginning of the destruction of the rugged peak of silicified breccia by the big blast, in June 1917, in which 10 tons of high explosive was set off in 10 deep-cham-



bered holes made with a churn-drill, supplemented by a few horizontal holes for 'step-blasting'. The population of Bisbee turned out, anticipating a thrilling spectacle, but the exhibition was disappointing; a few clouds of dust and smoke shot from the crevices, the huge mass heaved and then subsided, and no bombardment of the surrounding country enlivened the event. The rock, however, was thoroughly shattered, and a few weeks later the hill presented the appearance shown in the photo-

‡'Geology of the Warren Mining District,' Trans. A. I. M. E., Sept. 1916.

graph of what is known as the machine-shop bench, where it has attained the natural slope for broken material. The track is there laid ready for the work of stripping. Above this will be three more benches, 60 ft. apart vertically. The uppermost slice will be worked with a maximum face of 120 ft., yielding 300,000 cu. yd. of overburden. The lifts above the machine-shop bench will be reached by switch-backs, with the exception of the fourth, which will be gained by circling the hill on a 2½% grade. From the lower three benches the slices will be taken horizontally across the hill. The plan for the tracks on the several terraces, and the tracks for disposal of the waste, are shown in the accompanying plan. Bucyrus steam-shovels will be used for the work of excavation. After shoveling down to the machine-shop bench the next two terraces will be attacked by entering with tracks from the north-west side, 60 ft. and 120 ft. lower, and for the next bench, 60 ft. below this, it will be necessary to gain access through a deep cut past the power-house to the east slope of the hill. From that level the tracks probably will follow a spiral to the bottom. Many structures had been erected around Sacramento hill before it was determined that an orebody lay underneath. Among these was a large well-equipped machine-shop. This has already been removed. The power-house also will have to be moved before the East orebody is mined.

Conclusion. Sacramento hill will soon appear in the list of the great producing 'porphyries'. It is a unique property, and will repay attentive study by mining engineers, for they will acquire knowledge from it that may help to guide them in judging and developing other low-grade disseminated deposits of copper. Here is a hill but partly tested in which have been disclosed many million tons of ore, a property that had been under daily observation for 30 years before the presence of economic mineralization received confirmation, or was seriously credited except by a few. Here is an orebody concealed under a cap, the like of which is seldom found, originating from the slow intrusion of a stock of plastic granite porphyry, dragging with it a mantle of fragments torn from the formations traversed, a cap that gave no indication of the treasure hidden beneath it, and when at last it was revealed by exploration, renewed partly in the spirit of eliminating doubt as well as through active hope, it presented a rare and interesting individuality. Normal sulphate-leaching had been absent. Oxidation above did not enrich the material below, and yet the oxidizing copper did not remain; it was largely dispersed and only to a small extent was it fixed by carbonic acid. The familiar type of secondary chalcocite ore in a sericitized gangue is here seen as in so many other disseminated deposits, yet the chalcocite is merely an alteration-product from the primary sulphide; and, contrary to usual experience, Sacramento hill yields chalcocite ore, free from primary or secondary chalcopyrite, but in which an extremely large amount of pyrite exists. The geologic doctors have here an interesting 'case', which will soon be exposed for more minute examination.

Ballast

In the days of sailing ships and in the early development of steam vessels, ships could not make voyages without cargo. If, after discharging their freight, no return cargo was available, a load of ballast would be put aboard. This ballast of sand, stones, chalk, etc., usually amounted to one-quarter of the outbound cargo. The streets of Charleston, South Carolina, are paved with cobblestones brought in on ships that loaded cotton there. Around the English ports near the coalfields may be seen great hills of ballast, chalk, etc., brought from European ports to which coal had been shipped. Obviously much delay and expense resulted from the loading and unloading of this ballast. When ships were first built of iron instead of wood, various methods were tried to make the carrying of ballast unnecessary. An iron schooner built in 1856 was the first to adopt double-bottom water-ballast tanks. This is the most successful method yet devised to make sand-ballast unnecessary. About four years later an iron steamer was the first of that class to be so equipped. But along in 1865 double-bottom water-ballast tanks were in fairly general use. These enable ships to carry a weight of water equal to about one-sixth, in most modern ships one-quarter, of their cargo-carrying capacity. This water is held rigid and acts as solid ballast. Deep tanks, peak tanks, etc., are other forms in use additional to the bottom-tanks, enabling ships to carry a weight of water equal to one-fourth to one-third of their cargo capacity. In consequence of the continual development of the water-ballast tank construction ever since the 'sixties there are now very few ships afloat that require stone, sand, or other solid ballast. The rare exceptions are old ships, especially a few Great Lake vessels that are now on the ocean.

This development was a most important one, as trade conditions before the War were such that one-fourth to one-half of the voyages made by cargo ships, especially those not belonging to standard steamship lines, had to be made without cargo. Great numbers of ships continually sailed to all parts of the world with no ballast except water. If this was the condition in normal or peace times, it is still more the case today. In these days when the number of ships is inadequate, it is exceedingly fortunate that there is no necessity for ships to be delayed while loading and unloading ballast, when a voyage must be made without cargo, as happens so often. No more is it necessary for ships to be delayed in loading and unloading cargoes of goods, such as luxuries or non-essential commodities. Besides delay in loading the added weight makes the ship sink low in the water and travel slower, especially in calm weather. Also this greater amount of hull under water is a larger target for German torpedoes.

Copper production of Chile in 1917 amounted to 83,000 metric tons, against 63,580 tons in 1916.

Utah possesses an area of 13,300 square miles known to contain workable seams of coal.

Chart for Tonnage-Sampling and Dilution-Control

By HALLET R. ROBBINS

The accompanying chart has been designed to simplify as much as possible the control of mill-pulp dilution, and to eliminate the necessity for any calculations whatever by the operator. Three different kinds of determinations may readily be made by the aid of the chart, namely, dry tonnage per 24 hours, percentage of solid in wet pulp, and specific gravity of dry ore in wet pulp. The formulae on which the chart is based was furnished by R. B. T. Kiliani and are as follows:

1. Dry tons per 24 hours, $T = \frac{1440 \times 62.5 \times V a s}{2000\, t}$

2. Percentage of solid in wet pulp, $S = \frac{G(a-1)}{a(G-1)}$

3. Specific gravity of dry ore, $G = \frac{W}{W-(a-1)}$

Where

V = Volume of tonnage sample tank in cubic feet.
a = Specific gravity of wet pulp.
s = Percentage of solid in wet pulp.
t = Time in minutes for pulp stream to flow V cubic feet.
G = Specific gravity of dry ore.
W = Kilogrammes of dry solid in one litre of wet pulp.

The tonnage-sample tank used in the plant for which this chart was prepared measures 22 by 54 in. inside, and it is filled to a depth of $11\frac{5}{8}$ in., which allows for a sample of 1000 cc. to be taken from the pulp stream flowing into the tank, the net weight of which sample in kilogrammes is the a used in the formulae. For this particular tank, formula No. 1 reduces to $\frac{371\, a\, s}{t}$, and the chart is good only for this constant, but a similar chart could readily be prepared for any other constant.

To determine the dry tons per 24 hours, use the first line of figures across the bottom of the chart. Find a point whose ordinate is the observed a and whose abscissa is the observed t. Lay a ruler so as to touch this point and the lower left-hand corner of the chart (the origin). Where the ruler touches the vertical line corresponding to the correct dry specific gravity of the ore being sampled, read the dry tons per 24 hours.

Example 1. Observed $a = 1.18$, $t = 3.5$

G known to be 3.6; $T = \frac{371 \times 1.18 \times 3.6 \times 0.18}{3.5 \times 1.18 \times 2.6} = 26.4$

To determine the percentage of solid in wet pulp, knowing a and G, use the second line of figures across the bottom and the abscissa corresponding to the known ordinate a, and referring to the curve for the known G, is the desired s.

Example 2. Observed $a = 1.18$, known $G = 3.6$

$s = \frac{3.6 \times 0.18}{1.18 \times 2.6} = 21.1\%$

To determine the specific gravity of dry ore in wet pulp, use the third line of figures across the bottom. Find a point whose ordinate is the observed a and whose abscissa is the observed W. Lay a ruler to touch this point and the origin. Where the ruler touches the line marked 'Dry Ore Specific Gravity Line,' read the desired value of G on the same scale at the left of the chart used for values of a.

Example 3. Observed $a = 1.32$, observed $W = 0.450$

$G = \frac{0.450}{0.450 - 0.32} = \frac{0.450}{0.13} = 3.46$

Air-Blasts

The Kolar goldfield, which is situated in the State of Mysore, southern India, is noted for peculiar and violent explosions in the mine workings. These may occur in the quartz vein, or in the hornblende-schist, which forms the bulk of the country rock; or in the dolerite dikes, which cut the vein and the schists. They are most frequent and violent in the quartz, and are due to a strain in the rocks that causes violent fracturing when the potential energy is permitted to act, as occurs when mining operations have removed the supporting rock on one or more sides of a mass. In addition to the minor explosions, which occur at nearly all depths, in shafts, stopes, and drifts, there are heavy shocks caused by the giving way of pillars or other supporting masses of rock, with great rupture. This unusual violence is doubtless due to the fact that the rocks are already subject to internal strain. Several hypotheses have been suggested to account for these explosions, but the only one which, in the opinion of the writer, is adequate, is that the rocks of this field have been subjected to a great compressive force by crustal movements associated with igneous activity, and that the rocks have never been relieved from the resulting strain except near the surface and in local areas in various parts of the mines.—E. S. Moore in Bull. A. I. M. E.

COAL burned in stoves is a wasteful method. During the present stress arising from transportation difficulties, special efforts should be made to encourage the use of gas for domestic purposes. A ton of coal converted into gas will yield a heating efficiency equal to 2400 lb. burned on a grate, in addition to which it will yield about 1000 lb. of coke, 14 lb. of benzol, 18 lb. ammonium sulphate, 20 lb. of heavy oils, and 2 lb. of phenol.

CHEMICAL imports into the United States in 1917 were valued at $144,235,400, against $125,813,205 in 1916. Value of exports was $193,255,160, an increase of $27,969,152. Acid accounted for $52,695,640. Sulphuric acid amounted to 31,771 tons, a slight decrease. Dyestuffs increased from $7,953,986 to $16,107,361.

PETROLEUM DEPOSITS are being developed in the State of Alagoas, Brazil, not far from the coast. Oil is also reported from the interior States of Matto Grosso and Goyaz, and exploration of these deposits is also being made.

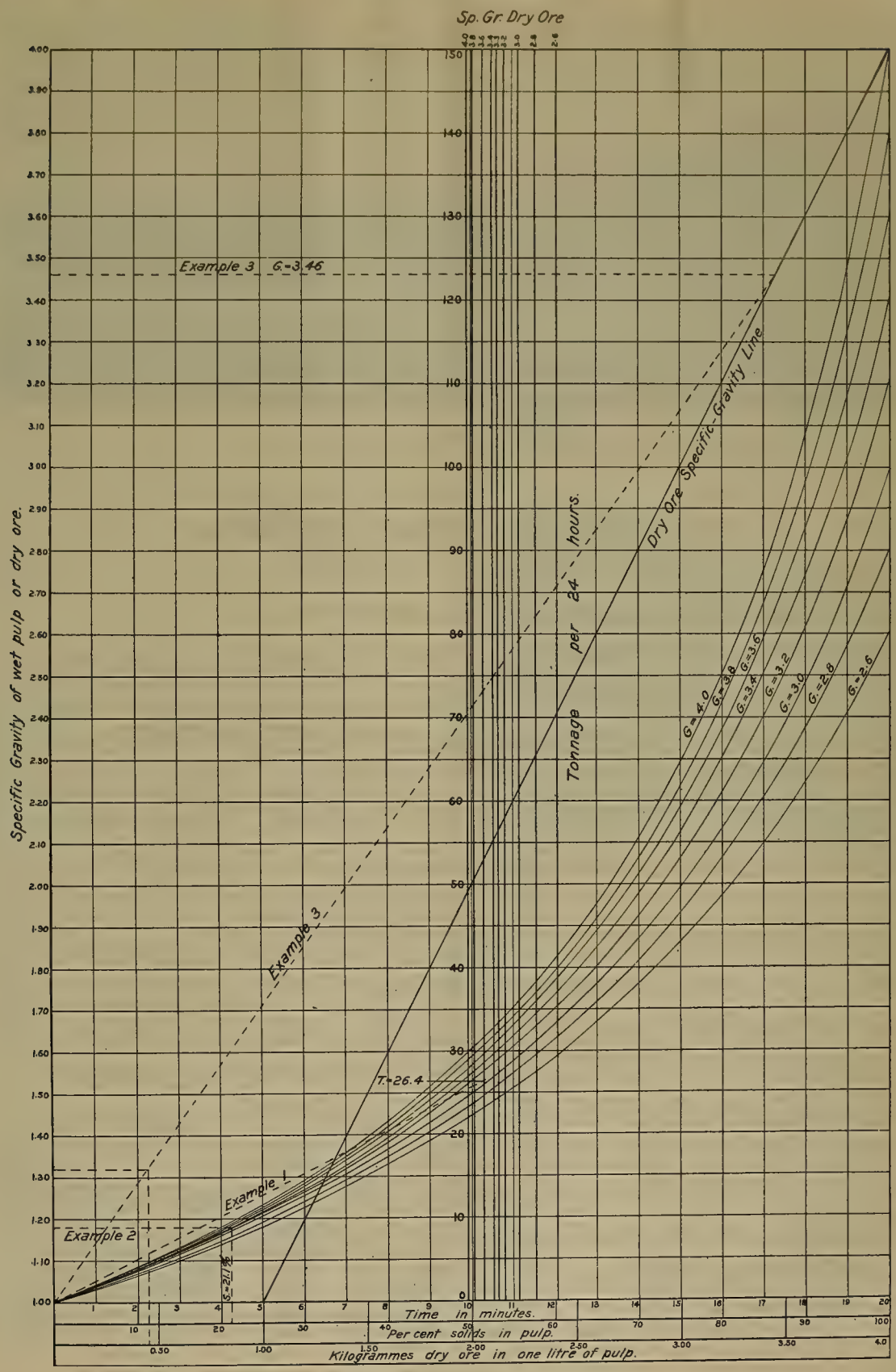


CHART FOT TONNAGE-SAMPLING AND DILUTION-CONTROL



THE 5000-TON CONCRETE SHIP 'FAITH'

Designing of Concrete Ships

By L. R. FERGUSON

*In designing a ship, it is assumed to be supported in two ways, first, for 'hogging,' and second, for 'sagging.' That is, the wave in one instance is supposed to support the ship in the centre, with the ends unsupported. In the second case, the ship is supposed to be supported at the bow and stern on the crest of the waves, the trough of the wave being under the centre of the boat. These waves are supposed to have a height equal to 1/20 of the length of the ship. Considering the ship as a beam, this produces alternate tensile and compressive stresses in both the top and the bottom of the structure. This governs the design of the ship as a longitudinal girder.

The ship must also be designed so that the sides and bottom will resist hydrostatic pressure. For this a system of transverse members called frames is provided. The accepted method of designing the frame is to consider the frame as a ring and to use the ring formula. This corresponds to the elastic-arch theory. Even with the supports fixed, the design of an elastic arch is not simple. With the concrete ship nothing is fixed. We must go through a long process to determine the position of the neutral axis in different parts of the frame, under the various conditions of external force that must be considered.

Around the frame is the shell. This has two functions to perform besides the primary one of keeping out the water. First the side may be considered as a sort of floor-slab, the load being the hydrostatic pressure that is distributed to the frames or transverse members of the ship. This is a comparatively simple matter, for the frames can be spaced to obtain the desired span. In addition to this, however, the shell acts in the same way as the web of a box-plate girder. The analogy can be carried further, the boat-frames can be considered as the stiffeners, and the deck and bottom of the boat as the flanges. The most important factor in designing the shell is the shear at the quarter-points. In this connection some interesting problems must be considered. For instance, do the frames increase the shear-section, and if so, to what extent? Does the bending of the vertical reinforcement of the shell into the bottom and deck anchor these rods sufficiently to produce the same effect as rigid attachment to the longitudinal reinforcement? Probably the most important question is the effect of alternate tensile and compressive stresses in the longitudinal members.

Let us now consider some of the advantages of the concrete ship. Such consideration must be governed by present conditions, although some of these conditions will continue after we have won the War.

The material to be used in building concrete ships is plentiful and widely distributed. It is not used for ships now being constructed, so there will be no interference with present programs. The class of labor to be used for the concrete ship is different from that used on either the wooden or the steel ship, and is mostly unskilled. Above all, the speed with which concrete ships can be built is of the utmost importance.

The maintenance cost of a concrete ship will be small, although the idea, held by many engineers, that barnacles will not adhere to concrete is erroneous. This, however,

*Extract: American Society of Marine Draftsmen.

can probably be overcome, and, at any rate, conditions will not be worse than for a steel ship.

The original cost of a concrete ship will probably be considerably less than steel or even wood. The resistance of concrete to fire is an important consideration. The shape of steel and wooden ships is governed to a considerable extent by the characteristics of the material used. With concrete, however, we can make the bow and stern conform to any conditions. The steel in the concrete ship can be placed where it will do the most good, whereas in both the steel and the wooden ship the efficiency of the material is often reduced considerably by the necessity of making joints.

One of the objections frequently raised against concrete for ship construction is that the weight of the material is too great. As a matter of fact, the weight of the hull of a concrete ship will be little, if any, more than that of a wooden ship of equal carrying capacity. The disintegrating effects of salt water on concrete is another objection. This, however, can be prevented by proper methods of protection. The possibility of corroding the reinforcing-steel is more serious. The investigations of marine structures conducted by R. J. Wig and myself showed the danger of cracking where reinforced concrete is exposed to moist sea-air, provided ordinary construction methods are followed. This too can be overcome by observing proper precautions.

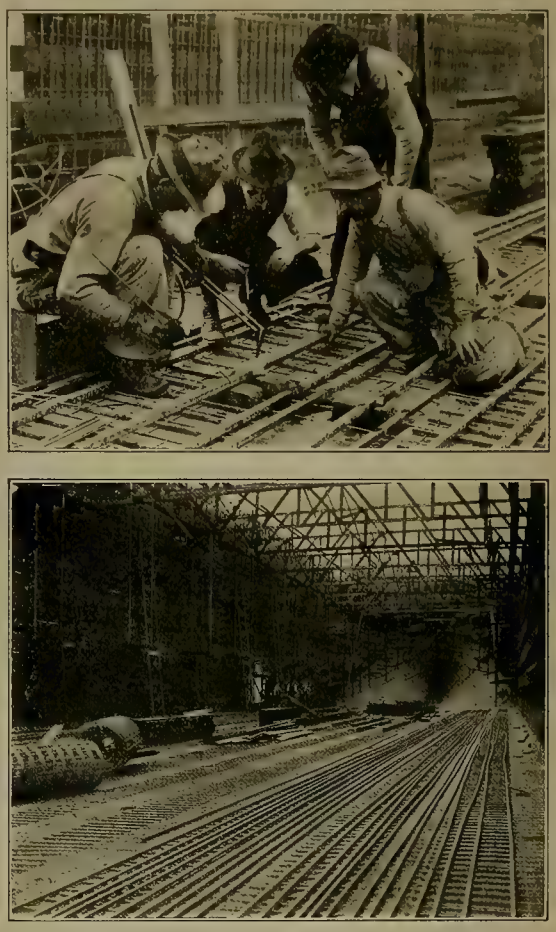
The First Large Concrete Vessel

On March 14 the 5000-ton reinforced concrete ship 'Faith', built by the San Francisco Shipbuilding Co., was successfully launched at Redwood City, California. While a number of barges and a few small self-propelled vessels have been constructed of concrete this is the first large ship to be built of this material. It was designed and constructed by Macdonald & Kahn of San Francisco.

The vessel is 336 ft. 3 in. over all, the length between perpendiculars being 320 ft. The beam is 44 ft. 6 in. and the molded depth is 31 ft. The draft is 24 ft. With this draft the carrying capacity will be 5000 tons. The empty hull draws 9 ft. of water. The concrete in the hull is from 4 to 5 in. thick. There are five concrete bulkheads. The bow is reinforced with a $\frac{3}{8}$-in. steel plate. The reinforcing-steel used in the hull weighs 550 tons. The main deck is of wood resting on concrete stringers. There are three cargo-hatches. About 2,000,000 ft. B.M. of lumber was used for the forms, of which about 10% can be used again, assuming a similar design.

Work was commenced September 1, 1917, and the first concrete was poured October 31. The last concrete was poured February 26, 1918. A water-proofing compound was used in mixing the concrete. The concrete was kept wet for three weeks after pouring, but it is evident that this rule was not strictly observed, since the vessel was launched 16 days after the last concrete was poured. A heavy black asphaltic paint was used on the outside of the hull.

The estimated cost of the empty hull is $450,000 and of the completed vessel, $890,000. The vessel will be



WELDING REINFORCING-BARS.—VIEW OF INTERIOR OF VESSEL

equipped with reciprocating engines developing 1760 horse-power. It is expected that the speed will be ten knots per hour. The vessel will be equipped and ready for service about June 1.

MOLDING SAND is formed as flood-plain deposits and as re-washed ancient beach-sands, that is, it is produced where there is a mingling of detritus from argillaceous deposits and rocks yielding sand, becoming intermingled under conditions permitting of their being worked over by water during which the excess of clay is carried off. The ancient beaches of glacial lakes are most favorable, and molding sand is often found at the lower levels of such deposits. Argillaceous sandstones and some decomposing granites, on being crushed, will sometimes yield a desirable grade of molding sand, and it may be prepared by mixing fine sharp sand or finely crushed quartz with a suitable quantity of clay.

Minerals Separation and Beer, Sondheimer & Co.

The following question and answer were made in the House of Lords on March 13, 1918, according to 'The Times'.

Lord Sydenham asked two questions concerning a German firm: (1) Whether the American branch of Messrs. Beer, Sondheimer & Co. of Frankfort, was black-listed and subsequently released; and (2) what conditions were imposed when this branch of the German firm was permitted to act for a time as agents of Minerals Separation American Syndicate.

Lord Hylton, who replied, said the information which the Government had was to the effect that Messrs. Beer, Sondheimer & Co., of New York, were included in the statutory list, generally called, he thought, the black-list in the United States, in July, 1916, and remained on that list until it was withdrawn on the entry of the United States into the War. It is perfectly true the Minerals Separation American Syndicate (1913) (Limited), which is a British registered company, entered into an agreement in the month of September, 1913, with Messrs. Beer, Sondheimer & Co., under which the firm were appointed the sole agents of the syndicate for the transaction of all commercial affairs of the syndicate in the United States of America, Canada, Mexico, Cuba, and the Philippine Islands. Messrs. Beer, Sondheimer & Co. have their principal office at Frankfort, and have a branch in America carried on by Messrs. Benno Elkan and Otto Frohnknecht, who were resident and domiciled in New York City. In October, 1914, the syndicate applied to the Committee on Trading with the Enemy for leave to enter into an agreement with Benno Elkan and Otto Frohnknecht, under which the syndicate appointed them as the American branch of Beer, Sondheimer & Co., its sole and exclusive agents for the transaction of the commercial affairs of the syndicate in the places already mentioned, and Elkan and Frohnknecht undertook not to pay or cause to be paid any money, etc., arising from or in connection with their trade relationship with the syndicate to Beer, Sondheimer & Co., of Frankfort, or any person resident in Germany or Austria, or to anyone for the use of such person during the War, and to defer until after the War any commission or remuneration payable to them. At that time Beer, Sondheimer & Co., of New York, were not black-listed, and no authority was required by the syndicate to enable them to enter into the proposed contract. They were informed by the Committee that there was no objection to their doing so.

In June, 1916, the syndicate approached the Treasury again. In view of their difficulties in America they had been advised to form an American Corporation to acquire from the syndicate the United States patents and the patents for Canada, Mexico, etc., and all their assets and other rights, but they were prejudiced by the agency agreement entered into with Benno Elkan and Otto Frohnknecht, the American corporation which was proposed being unwilling to submit to the obligation to deal with them. The syndicate, therefore, proposed to invite Elkan and Frohnknecht to cancel the agreement in return for a certain number of fully-paid shares in the company and an option to subscribe at par for further shares. The shares in question were ultimately to be converted into shares in the American corporation, and no benefit was to accrue in respect of them for five years. The substitution of a moderate share-holding interest in the company—£17,500 out of £200,000—appeared to be preferable to the control resulting from the exclusive agency under the agreement of 1914, and, after reference to the Board of Trade, the syndicate's proposal was sanctioned, subject, of course, to the approval of the Capital Issues Committee of the issue of shares if a new issue was involved. Meanwhile the syndicate received from America the agreement entered into there for the formation of an American corporation for the acquisition of its undertaking and assets, as finally settled. This agreement necessitated a modification of the proposed agreement with Elkan and Frohnknecht, putting an end to their exclusive agency. The shares which they were to receive as consideration for cancellation were to be placed at their disposal at the end of the War instead of at the end of five years, and Elkan and Frohnknecht were to be the general agents in the countries which I have mentioned, although not the exclusive agents, of the American company. On the other hand, they released to the British company the money to which they were entitled in respect of commission, which was stated to amount to from £16,000 to £20,000. The company stated that it was absolutely essential to continue this provision as to the agency, Elkan and Frohnknecht absolutely refusing to assent to its cancellation, and they pointed out that a leading American counsel had advised, in America, that the American branch of Beer, Sondheimer & Co. had no authority to enter into the new agreement or give the guarantee as to no-enemy benefit, and that the original agency agreement of 1913 was still in existence and could be enforced against the syndicate in the American courts. Meanwhile the name of Beer, Sondheimer & Co. of New York had been added to the statutory list. In all the circumstances the Treasury came to the conclusion that it was advisable in the national interest to authorize the company to enter into the agreement of August 4, 1916, with Elkan and Frohnknecht even though their right to be appointed agents remained, rather than to leave the company under their liability of the 1913 and 1914 agreements to employ them as sole and exclusive agents, and sanction was accordingly given, so far as the Acts and Proclamations relating to Trading with the Enemy were concerned. The Capital Issues Committee subsequently recommended the issue of fresh shares, out of which *inter alia* the shares to which Elkan and Frohnknecht were entitled were allotted to them.

Zinc chloride is in good demand at the present time, with prices ruling steady at about 10¼c. per lb. for prompt delivery.

Safeguarding Industries From Enemies Within

The National Americanization Committee makes the following recommendations to those in charge of industrial establishments:

1. Personnel Census and Current Registration. Take a census of the personnel and keep thereafter a current registration, dividing all workers into six groups: native-born, naturalized, first papers, second papers, alien enemies, all others. All subjects of the Central Powers as well as all other aliens without first or second papers, including both men and women, should be classified as of 'doubtful loyalty' from a safety viewpoint.

2. Plant Analysis. Make an analysis of the physical conditions of the plant, then chart or map the location of the vulnerable plants, noting particularly places where fire and explosions will do the most damage, where lights are important, where switchboards are placed, and where water-supply hydrants are located. The location of indispensable and delicate machinery which can be easily injured and is difficult to replace should also be noted. Include in this analysis the routing of products to local shipping-points to ascertain where they can be most easily tampered with.

3. Distribution of Employees. Ascertain how each vulnerable spot is protected and how it is manned, and then gradually shift into these places only native born men and women, who are in sympathy with present war policies. They should receive the best possible rates of pay. Their loyalty is your safeguard.

4. Surveillance Guards and Sentinels. Provide only those of native birth and place them in accordance with the results of this analysis, both as to the plant conditions and the distribution of employees.

5. Watchmen. Secure only those of native birth, vigorous and intelligent men, pay them the best possible wage rates and constantly remove all causes for dissatisfaction.

6. Permits for Workmen. Do not issue a general tag or number to foreign-born workmen which entitles them to visit at will different departments of the plant. The man who can do little damage when scientifically placed may be a good risk, but may prove dangerous if allowed to roam about the plant. Place restrictions on bringing packages into the plant and locate lunch-rooms away from danger zones or vulnerable spots.

7. Admission to Visitors. Require credentials and verify them, and see that visitors are permitted to go only to the places intended. Escort them in, stay with them and see them out.

8. Labor Turnover. Decrease the labor turnover in every possible way so as to keep down the number of new men and women taken into the plant. Find out as much as possible about all new employees and keep the information up to date.

9. Americanization Deputies. Appoint some employee as an Americanization captain who understands the alien. Give him a committee of leaders of the foreign-born if he wants one. It will be his duty to get in touch with the foreign-born employees, take some interest in them, see that they get the information they seek on registration, the draft, the interpretation of Government orders and other questions that come up. It will pay to keep close to the foreign-born employees and help them to get the right information.

10. Anti-American Activities. Remove as promptly as possible every cause or medium of unrest that enemies can work through, such as difficulties regarding hours, wages, housing, methods of employment, propaganda distribution, minor grievances, etc.

The Federal government cannot protect a plant that will not protect itself.

There is no time to replace either men or products.

Insurance covers your loss but does not help the Allies win the War.

Americanization insurance will help to win the War.

Restriction of Graphite Imports

The Committee on Mineral Imports and Exports, consisting of C. K. Leith, Pope Yeatman, and J. E. Spurr, representing the Shipping, War Trade, and War Industries Boards, have reported to E. F. Gay, of the Shipping and War Trade Boards, recommendations concerning the restriction of graphite importation from Ceylon and Madagascar, which have been approved by the War Trade Board. In accordance with the recommendations, a three months' embargo has been placed upon importations of graphite, and the importation for the remainder of the year will be limited to 5000 tons. The usual annual importation of Ceylon and Madagascar graphite is about 25,000 tons. The stocks on hand constitute sufficient margin of safety for this program.

The reduction of importation is made on the assumption that the production from Alabama, the chief source of domestic supply, will be commensurately increased. A great improvement in the standardization of domestic graphite as to size and purity must be made before the Alabaman flake graphite can win the confidence of the manufacturers of graphite crucibles. There has been considerable prejudice against using any of the domestic supply, and all makers prefer to use as little as possible, and seldom more than 20% in the formula in conjunction with 80% of Ceylon graphite. Satisfactory crucibles can be made from domestic graphite exclusively. It has been done, and it is entirely a question of standardizing the product. It has been suggested that the Alabama Graphite Association act as selling agents for the producers in the South and that it inspect, sample, and guarantee as to grade and analysis, all the material shipped to the manufacturers.

POTASH, in the form of the carbonate, is being offered to this country from Formosa. The amount available is 200,000 lb. per month, and it can be delivered at New York for about 52c. per pound.

Bill Creating War Finance Corporation

Among the many methods by which industries contributory to the war program may be financed through the Government, is a measure recently passed by Congress in the nature of a charter for a great corporation, having a capital of $500,000,000 provided through appropriation from national funds. It has received comparatively little attention among those engaged in mineral production. The preamble states the object as follows: "An Act to provide further for the national security and defense, and, for the purpose of assisting in the prosecution of the War, to provide credits for industries and enterprises in the United States necessary or contributory to the prosecution of the War, and to supervise the issuance of securities, and for other purposes."

The sections of interest to the mining world are given below.

SECTION 8. That the corporation shall be empowered and authorized to make advances from time to time upon such terms, not inconsistent herewith, as it may prescribe, for periods not exceeding one year, to any savings bank, banking institution, or trust company in the United States which receives savings deposits, or to any building and loan association in the United States, on the promissory note or notes of the borrowing institution, whenever the Corporation shall deem such advances to be necessary or contributory to the prosecution of the War, or important in the public interest: Provided, That such note or notes shall be secured by the pledge of securities of such character as shall be prescribed by the Board of Directors of the Corporation, the value of which, at the time of such advance (as estimated and determined by the Board of Directors of the Corporation) shall be equal in amount to at least 133% of the amount of such advance. The rate of interest charged on any such advance shall not be less than 1% per annum in excess of the rate of discount for 90-day commercial paper prevailing at the time of such advance at the Federal Reserve Bank of the district in which the borrowing institution is located, but such rate of interest shall be in no case greater than the average rate receivable by the borrowing institution on its loans and investments made during the six months prior to the date of the advance, except that where the average rate so receivable by the borrowing institution is less than such rate of discount for 90-day commercial paper, the rate of interest on such advance shall be equal to such rate of discount. The Corporation shall retain power to require additional security at any time.

SECTION 9. That the Corporation shall be empowered and authorized, in exceptional cases, to make advances directly to any person, firm, corporation or association, conducting an established and going business in the United States, whose operations shall be necessary or contributory to the prosecution of the War (but only for the purpose of conducting such business in the United States and only when, in the opinion of the Board of Directors of the Corporation, such person, firm, corporation or association is unable to obtain funds upon reasonable terms through banking channels or from the general public) for periods not exceeding five years from the respective dates of such advances, upon such terms, and subject to such rules and regulations as may be prescribed by the Board of Directors of the Corporation. In no case shall the aggregate amount of the advances made under this section exceed at any one time an amount equal to 12½% of the sum of (1) the authorized capital stock of the Corporation plus (2) the aggregate amount of bonds of the Corporation authorized to be outstanding at any one time when the capital stock is fully paid in. Every such advance shall be secured by adequate security of such character as shall be prescribed by the Board of Directors of a value at the time of such advance (as estimated and determined by the board of directors) equal to (except in case of an advance made to a railroad in the possession and control of the President, for the purpose of making additions, betterments, or road extensions to such railroad) at least 1.25% of the amount advanced by the Corporation. The Corporation shall retain power to require additional security at any time. The rate of interest charged on any such advance shall not be less than 1% per annum in excess of the rate of discount for 90-day commercial paper prevailing at the time of such advance at the Federal Reserve Bank of the district in which the borrower is located.

SECTION 10. That in no case shall the aggregate amount of the advances made under this title to any one person, firm, corporation, or association exceed at any one time an amount equal to 10% of the authorized capital stock of the Corporation, but this section shall not apply in the case of an advance made to a railroad in the possession and control of the President, for the purpose of making additions, betterments, or road extensions to such railroad. The Act from which the foregoing excerpts have been made is now law, having been signed by President Wilson on April 5.

NITRATE will be manufactured at Knoxville, Tennessee, from power developed hydro-electrically in that State, and in Georgia and Alabama. A report by a Committee of the Ordnance Department shows that, by inter-connection between the lines of eight power companies in that region of the Appalachians there will be 150,000 hp. immediately available for nitrogen fixation, which will be increased to 450,000 hp. by the end of this year, and to 680,000 hp. by the end of 1919.

ARSENIC, in the form of arsenious oxide, or 'white arsenic,' containing 99% As_2O_3, by order of the Food Administration is to be sold at not over 9c. per pound delivered to any point in the United States. This applies to less than carload lots. An advance upon this price of ½c. per pound is allowed to local dealers.

THE Hydro-Electric Power Commission of Ontario has installed recently the equipment for producing an additional 50,000 hp. from the plant of the Ontario Power Company.



NEW YORK

The Liberty Loan.—Gold Mining.—Appropriation for Mining.

Success is not always gauged by statistics alone. Four million persons subscribed to the first Liberty Loan; two billion dollars was asked; over three billion dollars was raised. The loan was a success. Nearly nine and a half million persons subscribed to the second Liberty Loan; three billion dollars was asked; over four and a half billion dollars was raised. This loan was also a success. The third loan is now being launched, and a large over-subscription is predicted, together with a large increase in the number of subscribers; but if five billion dollars is raised from fifteen million people with only three billion dollars asked, the result will not, in any way, reflect on the success of the previous loans. Since they were floated we have become educated to the idea of thrift, and the reason for the loan, and the justice of the cause for which financial support is asked. An evolution of ideas has taken place in the meantime. People are realizing their obligations to the Government, which is realizing the value of individual moral support, even from the humblest of us. The two first loans realized $5,808,766,150. To the captious critic who calculates that this represents but a small fraction of the available wealth of the United States the figures will indicate a lack of appreciation of the issues involved calling for caustic comment. The economist will use the statistics in a comparative manner to prove, without doubt, that a steady and satisfactory progress is being made fulfilling all reasonable expectations. Demands for the instant recognition of complex conditions bespeak a lack of appreciation of the fact that slow-moving reforms are invariably the more permanent. For this reason the net result of religious revivals is often negative. The War calls for the daily solution of fresh problems. It has stimulated research in avenues hitherto disregarded. It demands attention to matters previously ignored. Emergencies create men of action; but it would be unfair to assert that such men had wasted their latent abilities before the emergency arose. It is a matter for congratulation that such a great proportion of our potential energy remains in reserve to meet what demands the future has in store for us. If there was no future to consider there might be justification for the policy of clamoring for nothing less than the maximum possible. The Government might, with this idea in view, call for donations to the Treasury rather than subscriptions to a war loan; but it knows well that steady success is best obtained by conserving individual earning power, individual credit, and individual resources as much as possible. The same argument also applies to all other private or national effort. The spectacular achievement too often prejudices sustained effort.

The high cost of production has extended to an industry where there is little hope of any corresponding rise in the market price of the product. Gold mining has been adversely affected to a considerable degree, and the net result is seen in a progressively declining production. During March, the Transvaal reported less gold output (696,000 oz. for the month) than during any previous month since the outbreak of the War. South Africa produces a large proportion (41%) of the world's output of yellow metal, and statistics show that 27,862,851 tons of ore was milled on the Rand in 1917, against 29,175,468 tons during the previous year. The yield declined in value over six million dollars. In the United States it has been estimated that the increased cost of mining and milling gold ores has risen 18% during the past year; and this, in large measure, accounts for the precarious position in which a great number of small concerns and a few large producers are placed. There has been a steady decline in domestic production of gold since 1915, when the value stood at $101,035,700. During 1916 it dropped to $92,390,300, and for 1917 the production was only worth $84,456,600. This phase of economics was discussed by a committee recently appointed by the New York Section of the American Institute of Mining Engineers to report on the effects of price-fixing and taxation as affecting the mining industry. Attention can be drawn to the unsatisfactory condition of gold mining, but beyond that it is difficult to go. It is impossible to consider the raising of the market-value of the metal, and it is equally impossible to view with any optimism the prospect of reducing the cost of labor or materials required to produce it.

Much interest is being displayed in the suggested appropriation of $50,000,000 to aid the prospecting for and exploitation of properties in the United States for the purpose of encouraging the output of various metals. The minerals found in the United States but now imported in quantity are manganese, pyrite, platinum, mercury, wolfram, sulphur, tin, and graphite. Graphite comes from Ceylon, pyrite from Spain, platinum from Columbia, manganese from Brazil, etc. The encouragement of local production is praiseworthy, and the discovery of additional deposits of the less valuable minerals mentioned would release many ships now engaged in the import trade, and would tend to stabilize the prices of the products.

PLATTEVILLE, WISCONSIN

Conditions in March.—Ore Prices.—Improvements.

During March the zinc-lead region found many obstacles in the path of regular operations. These were, lower prices for ores, a bad storm of sleet knocking down telephone and power lines, damage to plants, and bad roads. Production fell at mid-month to 50% of normal.

Prices at the beginning of March were $61 per ton for 60% zinc ore, and $58 for second grades. Ten days later these fell away to $60 and $55, respectively; followed by $58 and $53 at mid-month, and $53 and $48 at the end. On lower grades, ordinarily sent to refining plants, buyers of 55% ore offered $45 at the close of the month, $40 for 50%, $31.50 for 45%, $27 for 40%, $25 for 35%, and $21.50 for 30% ore. Low-grade producers restricted output, shipments of finished ore were withheld, and deliveries were light. Reserve of all grades in the field at the end of March was carefully computed as in excess of 5000 tons. Operators were despondent over the immediate outlook. Many expressing the belief that the bottom had not been reached, and it was mooted strongly in many quarters that shut-

downs of low-grade producers would become imperative unless a change for the better manifested itself quickly. Lead-ore prices were firm throughout the month, $87.50 to $90 per ton being offered. About the 15th there was a recession to $85. This is a fair price, as lead is a by-product in Wisconsin. Pyrite in reserve at the beginning of March was over 6000 tons, but this was reduced to 1500 tons by April. The price was only 7c. per unit of sulphur. Wisconsin pyrite contains from 30 to 35% sulphur.

Improvements aiding operations in the field included the use of gondola coal-cars with wood bottoms covered with burlap for carrying concentrates, completion of zinc-oxide works at Hillsboro, Illinois, for treating carbonate ore, and better labor conditions brought about by negro help.

VICTORIA, BRITISH COLUMBIA

Summary of Mineral Production in 1917.—Government Aid to Mining.

In submitting to the Legislature Assembly his estimate of expenditure for British Columbia during 1918, the Hon. John Hart, Minister of Finance for the Province, gave an illuminating summary of its mining activity throughout the past year, taking a most optimistic view of the prospects for 1918.

For the year 1917 the approximate value of mineral production was $37,182,570. That for 1916 having been $42,290,462 it will be seen that there was a decrease of $5,107,892. The total mineral production of the Province to the end of 1917 reaches $595,743,285. It must not be taken that there was any decline in the industry itself during 1917, the explanation being found in the cumulative effect of several adverse influences, such as: industrial troubles, reduced metal prices in the last quarter of the year, less demand for lead and zinc for munition purposes, and economic conditions that severely handicapped the mining for gold.

The output of metalliferous mines during 1917 is estimated as $27,663,786, against $32,063,514 in 1916. The most serious decreases were in production of gold, copper, and zinc. Gold, which fell off $2,173,834, was set back mainly because of the decline in the Rossland field, which usually provides 55% of the output; also because of the increased cost of labor and supplies. Copper, which shows a decrease of $1,091,457, and zinc, $1,493,872, were directly affected by industrial troubles. The extraction of 61,416,617 lb. of copper and 33,776,335 lb. of zinc, both greater than shown in any previous year except 1916, must be considered satisfactory under the circumstances. Silver and lead increased $359,435, which is especially gratifying. Production of coke was 159,554 long tons, an increase of 40.5%. About 129,155 tons was produced by the Crow's Nest Pass Coal Co., being a drop of 110,960 tons. Having met with a series of misfortunes early in the year, a condition aggravated by shortage of labor, this company's collieries were unable to maintain their output and, as a direct consequence, the large smelters of the interior were unable to obtain their usual supplies of fuel. This is one of the chief explanations of the failure, although by a small margin, why the value of the Province's metalliferous mines output in 1917 was less than that of 1916. It is estimated that the net coal production for 1917 was 76,324 long tons greater than in 1916, again nearly approaching the pre-war rate. The Vancouver Island collieries made an output of 1,698,235 tons, a record, a gain of 205,474 tons. Production of British Columbian collieries in 1917 was valued at $8,518,784, a decrease of $381,891.

The total quantity of ore mined in British Columbia in 1917 approximates 2,597,725 tons, against 3,200,000 tons in 1916, and 2,700,000 tons in 1915.

The effect of the application during 1917 of the Mineral Survey and Development Act was as follows: In accordance with its provisions the Province has been divided into six mineral survey districts, with qualified engineers in charge of each. On their recommendations the expenditure of $127,628 has been authorized for construction of roads and trails to mines. Prospectors, operators, and generally all engaged in mining have welcomed this measure as one to stimulate production. Under this Act, diamond-drilling is to establish as nearly as possible the available quantity of iron ore in British Columbia; also the best means of establishing a modern plant for its reduction to metal.

CRIPPLE CREEK, COLORADO

General News of the District.

The United Gold Mines Co. has made an important discovery in its Wild Horse mine on Bull hill and is again producing steadily. By a raise, driven for ventilation between the Gleason and Wild Horse workings, there has been opened 3 ft. of smelting-grade ore, between the 400 and 300-ft. levels of the Wild Horse shaft. A 10-in. mud-seam carries from 5 to 10 oz. gold per ton by grab sampling. A shipment of over 2-oz. ore was made last week. Carl Evans is superintendent.

Two cars of high-grade ore, under armed guard, was sent from the Cresson mine on April 12. This ore was mined from a new shoot, reported to be 30 ft. wide, on the 1000-ft. level.

Diamond-drills will soon be used for prospecting in Cresson ground from the Roosevelt drainage-tunnel, at a depth of about 1800 ft. from the surface. A station is now being cut for this purpose in the Cresson lateral at a point 600 ft. north of the tunnel in the Old Ironsides claim of the United Gold Mines Company.

The Portland company has declared the regular quarterly dividend of 3c. per share payable April 20. The amount, $90,000, will bring the total sum paid to $11,137,080.

The final clean-up at the Colorado Springs mill of the Portland company commenced on April 8. Machinery is to be shipped to the company's Independence mill at Victor. Most of the millmen are to be given employment at this plant.

The El Paso Extension, operating the Index mine on Gold hill under bond and lease, is shipping steadily, 12 cars having been loaded since the first of April. Settlements have ranged from 1 oz. to nearly 3 oz. The car of the latter grade was mined at the 300-ft. level by sub-lessee. The company ore is mined at a depth of 1115 ft., and is worth close to $30 per ton. Low-grade ore mined by sub-lessees in other levels realizes $18 to $20 per ton.

Harry MacDonald, cashier of the Cripple Creek State Bank, has been appointed manager for the Patterson-Bradley Leasing Co., operating the Specimen and Sacramento mines of Stratton's Cripple Creek Mining & Development Co. Deep development is planned for these two Bull Hill properties.

The Du Pont de Nemours Powder Co. is about to construct a suitable magazine in this district, to be on the north-east slope of Tenderfoot hill. Surveyors have staked the grade for a track to the site, extending from the High Line road at Hoosier Pass, and grading is under way.

The monthly dividend of the Golden Cycle company of 3c. per share, $45,000, was paid on the 10th.

The Vindicator Consolidated company again decided to pass the quarterly dividend. The company has paid its taxes and current expenses, and has approximately $100,000 cash on hand. George A. Stahl has been elected general manager to succeed Irving T. Snyder, who resigned. The former has been secretary for many years.

The Ajax Gold Mining Co. has decided to dissolve the corporation. The properties formerly owned by the company on Battle mountain are being operated by the Carolina company.



ALASKA

Fairbanks.—First coal shipments from the Nenana field reached Nenana early in February. This comes from Lignite creek, and more is to be hauled to the present end of the railway. The more accessible part of the Nenana field has been divided into leasing blocks, none to exceed 2560 acres. There are at least 12 coal beds of workable thickness, six being over 20 ft. The coal is a lignite of fair grade, suitable for interior Alaska.

Strelna.—Ion E. Barrett and Mr. Dwyer, agents for the Copper River & North Western railroad, report that Ole Berg has developed over a million dollars worth of gold ore in his mine near here.

ARIZONA

Bisbee.—This district is producing 1000 tons of manganese ore per month. The Higgins Leasing Co. is shipping 150 tons weekly, mining this from near the surface. Calumet & Arizona and Copper Queen also produce the ore.

Douglas.—Calumet & Arizona smelter produced during the first three months of 1918 approximately 20,000,000 lb. of copper, an increase of nearly 4,000,000 lb. over the yield for the same period of last year, which was 16,708,133 lb. Total production of the smelter for 1917 was 93,037,123 lb., of which 33,683,983 lb. was from custom ores, making the Calumet & Arizona output for the year 59,353,140 lb. In 1916, the production of this company was 70,041,139 pounds.

Globe.—Ore carrying several hundred ounces of silver and 30% copper has been extracted from the Manibesta Copper & Silver Co.'s mine in El Capitan district. High-grade copper ore carrying silver is also being mined at Copper Vault property in the Cole-Goodwin district. J. J. Sherwin is in charge.

Billy Hogerty and Harry Malloy have, in cross-cutting 300 ft. on their claims in Mineral Creek district, cut a vein over 40 ft. wide, of which 5 ft. carries 28% copper, $6.40 gold, and 10 oz. silver per ton. They estimate an immense tonnage of lower-grade ore, averaging better than $30 per ton in the three metals.

Hackberry.—On 700-ft. level of old Hackberry mine there is 5 ft. of 80-oz. ore. Reserves in mine are estimated at 200,000 tons, assaying 20 oz. silver per ton, with some gold, lead, and zinc. A 200-ton concentrating plant is to be erected.

Jerome.—Sinking has been resumed at the Verde Combination from 700 to 1000 ft. In March 730 ft. of development work was done.

Softer ground is being encountered in the shaft of the Gadsden, which is down 968 ft. The pump in use on the 800-ft. level will probably have to be returned to the United Verde Extension, which will delay sinking if the new pump does not arrive.

The United Verde Extension has encountered a heavy flow of water.

Oatman.—Tom Reed company has opened Bald Eagle vein for 500 ft. on 525-ft. level. Average width is 7 ft. Mill is producing gold worth $150,000 per month.

The Telluride is drilling, hoping to cut main vein of Tom Reed.

Parker.—The Red Cloud Consolidated Mining Co. has just purchased machinery including two sets of rolls, a crusher, and two concentrators.

Prescott.—The General Mines Co., developing the Amulet mine in the Walker district, has its new shaft down 200 ft., and has cut high-grade silver-lead ore in the north drift.

A new 34-hp. gasoline engine is being erected at the Arizona-Portland in Copper basin.

Fitzmaurice and Birch are erecting a new water-propelled quartz mill on their gold mine on lower Lynx creek.

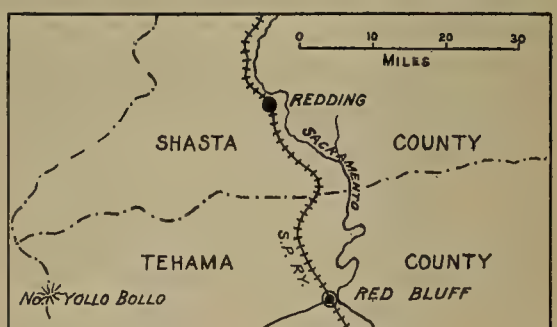
Tucson.—The American Mining Congress Arizona Chapter met here on April 8 and 9. About 30 representatives of the mining districts attended. The bi-monthly meetings, started in 1917, are mainly to aid the Government in every way. It was resolved to do everything asked by the authorities to help put down disloyalty, not to employ members of the I. W. W., that the mining industry should not be subject to any sub-department but by a department of mines headed by a member of the Administration and that the U. S. Bureau of Mines should not be transferred to the War Department.

Willcox.—The Mascot Copper Co.'s mine here, under 10-year lease to the A. S. & R. Co., was returned to the owners on April 1. No reasons were given for this action. About 35,000 tons of ore, valued at $500,000, has been extracted.

CALIFORNIA

Angels.—The Angels Camp Deep Mining Co. has resumed operations, in charge of J. C. Benson, president. The main shaft is to be sunk, and electric power used in place of steam. M. Fugina is superintendent.

Red Bluff.—Ten 850-lb. stamps and two Wilfley tables have been started dressing disseminated chrome ore at the



MAP SHOWING CHROME DISTRICT OF TEHAMA COUNTY, CAL.

Kleinsorge property, 7 miles from Lowrey, and 40 miles south-east of Red Bluff. Water-power, under a head of 520 ft., has been developed. This property is in rough country, necessitating use of three aerial trams. The Milton

section produces shipping ore in considerable quantities, as do other scattered parts. A feature of the area is large quantities of disseminated chrome in serpentine, which needs concentrating. Later on we hope to publish details of results obtained. North of the Kleinsorge are several other chrome producers. H. D. Jerrett is in charge.

Caliente.—Toll Gate Mining Co. has been permitted by the State Corporation Commission to issue 24,995 shares to L. D. Collings in consideration for the assignment to the company of all his right, title, and interest in a contract to purchase seven mining claims in Toll Gate canyon, 20 miles east of Caliente, Kern county. Collings is also to pay the company $6000, which is to be used for the installation of mining and milling equipment.

French Gulch.—Forty men are working at the Sybil mine and ten stamps are crushing ore. Good ore was cut recently in new ground opened from the shaft. The mine is operated by William Blagrave and William Franck.

Los Angeles.—According to the Chamber of Mines and Oil the first potash prospecting permit has been issued, covering 2560 acres of marsh land in Inyo county. Under the new law permitting the exploration of potash lands, a corporation or individual may secure the exclusive right to prospect on 2560 acres of supposed potash land for a period of two years. Discovery of potash in commercial quantities will entitle the permittee to patent for 640 acres, the balance of the 2560 acres being retained by the Government to operate or lease at its discretion. In the past there has been no incentive to develop potash deposits, to which title could not be acquired.

St. Louis.—The Loftus Gold Mining Co. of Los Angeles has started hydraulicking near Howland Flat in Sierra county. It is reported that over $200,000 has been spent in ditches and an impounding dam, also that 10,000 yards of gravel will be sluiced daily.

Smartsville.—A. C. Paul has taken bond and lease on Green Lead copper mine from Thomas Mooney of Marysville, and started work. The mine produced 30 years ago, ore being shipped to Swansea, Wales. Mr. Paul is operating the McGonigal property profitably.

COLORADO

Central City.—The Perigo mines and mills at Perigo have been taken over by S. J. Gish and D. W. R. Finney, who are to re-open the workings and re-model the plants.

Cripple Creek.—The Cresson profit for March is expected to be over $100,000. Drift No. 915 has opened ore averaging $50 per ton.

Ouray.—The Camp Bird adit was driven 515 ft. during March. The main vein is expected to be cut by the middle of May, when driving both ways will be commenced and continued for a distance of 1500 ft., and raises of 500 ft. started to connect with shaft workings above.

The Mountain Top M. & M. Co. is operating at full capacity, both milling and shipping crude ore. Concentrate is of high value. G. Barnhart, the manager, hopes to sink on the vein several hundred feet into the andesite formation to prove the theory that richer ore is below the present workings, which are in rhyolite.

Ouray Mining, Smelting, Milling & Refining Co., Thomas Crawford in charge, is pushing completion of two mills for concentration of low-grade ores. The one at Ironton will be ready by May 1, and the one connected with the smelter below this city was expected to be ready by April 15. The smelter would be in operation now if there were sufficient copper sulphide ores available. Mr. Crawford has leased the Treasury Mining & Tunnel Co.'s property at Red Mountain and expects to commence operating these after June 1, 1918.

Among the new ventures will be the Hudson Leasing Co., which will unwater the Hudson mine and commence mining copper ores. Otto Arps is president of this company.

Rico.—The Pro Patria claim has been opened by the Rico Mining, Light & Power Co., and a large force of men is at work.

Muddy roads are interfering with ore hauling.

The Rico Argentine and the Rico-Marmatite lease are shipping heavily.

The Cadiz mine has a number of cars ready for shipment.

IDAHO

Arco.—Wilbert Mining Co. is sinking new shaft to depth of 800 ft., now down 250 ft. Monthly progress is 150 ft. A little ore is being mined at 300 ft., and the mill works intermittently. In a block of ground at 800 ft. depth there is estimated to be 5000 tons of ore blocked out, some carrying 50% lead and 15 oz. silver per ton. Mine is in the Dome district, 35 miles from rail at Arco.

Elk City.—In the Ten-Mile district of Idaho county there are 8 mills working or in course of erection. These are at the New York, Mackey, Lone Yellow Pine, Gilt Edge at Newsome, Davis, Warder, and Black Pine and Mineral Zone at Elk City. The plants use stamps and Gibson mills. Miners and millmen are in demand.

Porthill.—The Idaho-Continental company, in charge of A. Klockman, resumed mining and milling last week, after a shut-down since last fall due to lack of water. The plant is dressing 200 tons of lead-silver ore daily. About 100 men are employed.

Wallace.—Success Mining Co. on Nine-Mile creek suspended operations last week, on account of a dispute with the Graselli Chemical Co. over payments for zinc ore delivered. Directors are to go to Washington, D. C., to complain to the authorities.

MISSOURI

Joplin.—Production of the region last week was 6140 tons blende, 210 tons calamine, and 1242 tons lead, averaging $41, $35, and $85 per ton, respectively. Total value was $365,419, making $7,199,321 for 15 weeks. Oklahoma contributed $226,862 to last week's total.

MONTANA

Butte.—Anaconda company, while cross-cutting from its Belmont mine to the 2500-ft. level of the Davis-Daly for ventilation purposes, last week cut 5 ft. of 8% copper ore.

Davis-Daly's Colorado mine is shipping 250 tons daily of ore assaying 11 to 14% copper and 12 oz. silver, and 4% copper and 6 oz. silver per ton. About half is of the first grade. Sinking at the Hibernia is hindered by water.

Kendall.—Barnes-King Development Co. in March extracted gold worth $55,036 from 5622 tons of ore. The grade varied from $5.49 to $11.20 per ton. The February yield was $72,455.

NEVADA

Beowawe.—Salt Lake City people have acquired the Silver King mine and appointed J. B. Lamb as superintendent. A 35-hp. hoist has been sent to the mine and preparations made for early shipments. Ore carries silver and lead, with best grade assaying $130 per ton.

Bruner.—Bruner Con. Mines Co. has established a camp and post-office, and is operating with 32 men. Water will be brought to camp from O'Neil springs, 10 miles distant. A 150-ton mill will be erected in 25-ton units. Development has been in progress eight years. Main offices are at Kansas City, Missouri.

Bullfrog.—This district is active. The Mayflower is shipping $22 gold ore to Kennett, Cal., smelter, and has 10

stamps dropping. The remaining five stamps will be working shortly, and capacity of mill probably increased. Development is proceeding from 200, 300, and 400-ft. levels of Mayflower shaft, and from surface workings on Starlight claim. Shipping ore is mined on Mayflower vein at points 1400 ft. apart. W. J. Tobin is manager.

Fallon.—The Nevada Potash Syndicate has started drilling in Dixie valley to test brine beneath rock-salt deposits. The manager, E. N. Richardson, states that silt overlying salt-beds assays 2 to 3% potash.

Goldfield.—Re-treated tailing from the Goldfield Consolidated mill has been leased to M. G. Bradshaw and others, who will sweep dumps for the rich material that collects on the surface.

Goodsprings.—In the Annex mine there is now 7 ft. of rich lead-silver ore, an important development.

At the Hoosier, work is under way on the mill-site. A 4½-mile water-pipe line is being laid.

The Yellow Pine company has purchased Liberty Bonds amounting to $25,000, making $100,000 to date.

Hazen.—According to F. M. Manson of the Western Ore Purchasing Co., development of chrome and manganese deposits in this State will be considerable within a few months. His company has arranged to handle small or large lots of these ores, paying for them at the smelter as is done with other ores.

Nelson.—Considerable interest is being aroused here (Clark county) by exploitation of Copper Canyon by the M. & D. Mining Co. of Salt Lake City. An Okell drill, using a specially treated steel cutting-tool, and taking out a five-inch core, has been set up in Copper Canyon, one mile from Nelson. Drilling is under way, and the management is prepared to go to 900 ft., and expects to reach primary chalcocite at 800 ft. Already $122 gold-silver-copper ore has been taken out. An average taken over 125 ft. of the exposed orebody on the surface showed 3% copper. The president of the M. & D. company believes this orebody to be the outcrop of an extensive zone lying east and west.

A combination air pipe-line and water pipe-line is being laid down from the Techatticup mine to the Crown Queen mine. The latter is expected to start soon.

Rand company is now working both mine and mill, having obtained enough water.

Tonopah.—Some March outputs were as follows:

Mine	Tons	Silver, oz.	Gold, oz.	Profit
Belmont	9,040	114,499	1,172	$63,200
Tonopah Mining	15,102	113,103	1,143	41,200

There is nothing of importance from the Divide district this week.

The Monarch Pittsburg Mining Company, through its superintendent, B. H. Smith, reports that during 1917 there was 1649 ft. of development done at a cost of $14.27 per foot. Certain work in progress resulted in ore being discovered at about the 900-ft. level. Drifts on 850-ft. level exposed a persistent body of $3 to $11 ore, but later on it became bunchy and erratic. The West End company having opened its Ohio vein on 500-ft. level, it was decided to prospect that part of the Monarch Pittsburg above the 850-ft. level in search of this vein. A raise is up 160 ft. in rhyolite toward the overlying trachyte. Geological conditions are considered better than before for finding large bodies of ore. Receipts during 1917 were $35,395, of which $28,595 was from assessments and $1100 from ore sold. Cash balance of $4304 at beginning of year was wiped out.

NEW MEXICO

Lordsburg.—The new 400-ton gravity and flotation concentrating mill at the Eighty-Five mine is in commission. It is driven by a Diesel electric-power plant. Ore carries copper, gold, and silver. Deepest shaft is 750 ft., with more than four miles of underground workings. A. J. Inderrider is manager.

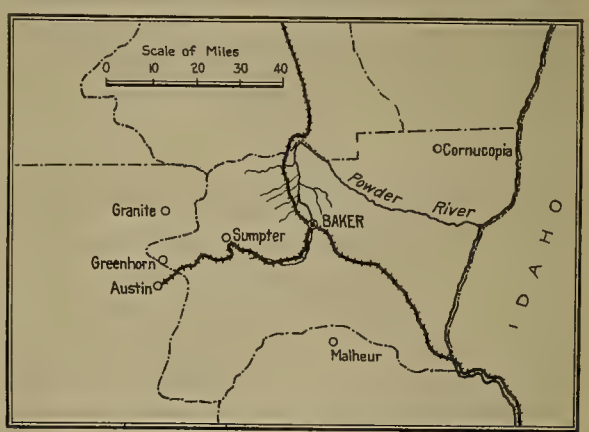
North of Lordsburg is the new mining camp of Redrock, where are big deposits of fluorspar being developed. The mineral will be hauled to Lordsburg by auto-truck, and shipped to San Francisco. The ore contains silica, 0.4%, lime, 50.17%, and fluorine, 48%. J. A. Cauthen is manager.

Silver City.—The deposit of manganese ore on Boston hill, west of Silver City, is extensive, as shown during the last year's development by Robert I. Kirchman and Perry Crawford, who for 12 months have shipped to Pueblo, Colorado, 1500 tons per month. A more uniform price for manganese ore and a better supply of cars would enable them to ship from 10,000 to 20,000 tons per month.

OREGON

Sumpter.—Powder River Gold Dredging Co. reports as follows, through C. W. Gardner, manager for the Hammon Engineering Co., which is in charge of the property:

During year ended September 30, 1917, gold extracted



MAP SHOWING BAKER COUNTY DISTRICT, OREGON

was sold for $516,234, of which $314,990 was profit. Current assets were $183,808, and liabilities $20,690. No. 1 dredge will continue to dig a good quantity in 1918, but with decreased gold content; while it was expected that No. 2 would have finished its ground by December last. Ground near Breckenridge, Colorado, was acquired on terms, and a boat was to be finished late in December 1917. Estimates place gravel in this new property at 15,000,000 cu. yd. Some details of operations last year are as under:

	No. 1 dredge	No. 2 dredge
Ground dredged, cubic yards	1,617,846	1,993,067
Average daily operating time, hours	19.97	20.71
Average daily yardage	4,829	5,862
Gold recovered, cents per yard	17.04	12.07
Cost, cents per yard	6.13	5.12
Net profit	$176,566	$138,424

Compared with previous year the profit was 18 and 37.3% less, respectively.

OKLAHOMA

Douthat.—Skelton Lead & Zinc Co. is the second largest producer in the Oklahoma field, and has 7 mills dressing 1000 tons of ore per shift.

Picher.—Production of Oklahoma districts last week

amounted to 3661 tons blende and 860 tons lead, valued at $226,862.

Tar River.—A year ago this place was of no importance; today it has a population of 6000 people, and is the centre of much mining activity. Originally it was called Cardin. There are about 100 mines and mills in the district.

TEXAS

Dalberg.—The West Texas Mica Co. of Houston is developing, mining sheet, and producing large quantities of ground mica from an extensive deposit 9 miles from this place. This ground mica is made into what is known as 'golden bronze,' used for decorative purposes. The region in which this ore occurs is typically desert. This company, with a capital of $2,500,000, started operations in 1910. An interesting feature is the manufacture of chicken grit.

Quanah.—Considerable quantities of copper ore are being shipped by companies operating in Hardeman, Archer, and other counties of this region. The Texas Development & Mining Co. is developing a claim in Haskell county, and is preparing to erect a concentrating plant. It is stated that this mill will be at Ruíe. T. Stanford Gibbs of Chillicothe, who holds a lease on 18,000 acres in Hardeman county, including Medicine Mound where copper mines were worked 25 years ago, is extracting copper nuggets in sufficient quantity to make regular shipments. Since December 20, 1917, he has shipped three cars of this material to the smelter. He proposes to build a plant.

UTAH

The Utah Oil Men's Association was formed at Salt Lake City last week to look after the oil industry of this State. E. D. Woodruff was appointed president, and G. F. Barton secretary.

Alta.—Wasatch Mines Co. recently received settlement for a car of ore containing 110 oz. silver, $2.13 gold per ton, 25.5% lead, and 1.5% copper. Value was $112 per ton. The drainage-adit is in 1950 ft., cutting a few seams of galena.

Transportation troubles up the canyon include deep dust on the main road and 4 to 5 ft. of snow along the sides. The Little Cottonwood Transportation Co. expects to have its line complete to the mines this summer. Haulage to smelters from Alta will be from $2.50 to $2.75 per ton.

Lark.—Ohio Copper Co.'s new flotation plant is to be ready by May 1. Mill consists of three units of 600 tons each. It will dress slime from the old mill, which is handling over 2000 tons daily, extracting about 50%.

Park City.—Ontario Silver Mining Co. has opened large shoots on 1600 and 1700-ft. levels. During 1917, company sold ore worth $315,159 and silver $123,753. Assets at beginning of year were $311,620, and at end $376,299. Latter includes stocks and bonds valued at $316,023.

Provo.—Dragon Consolidated paid 1c. per share on April 25. This amounts to $18,750, and makes $37,500 for 1918 and $112,500 to date.

Tintic.—Iron Blossom pays 2½c. per share on April 25, equal to $25,000. Total to date is $3,125,000.

Chief Consolidated paid 10c. per share on May 6, equal to $88,420. This makes a total of $1,013,811.

CANADA

British Columbia

Ainsworth.—The Florence Silver Mining Co. is again working its mill one shift daily, dressing 90 tons of ore. In March, products sold realized $21,219. On April 25 two shifts were started, and 30 additional men employed, making 75 in all. New quarters are available for the men.

Princess Royal Island.—Surf Inlet mine of Tonopah Belmont company made a profit of $33,000 during February.

Silverton.—Standard Silver-Lead Mining Co. made a profit of $377,494 in 1917, against $388,364 in 1916. Receipts were $867,551. Dividends amounted to $300,000. Balance brought forward to 1917 was $202,801, and to 1918, $336,943. Lead ore was sold for $364,046, and zinc ore for $462,792.

Ontario

Kirkland Lake.—The Burnside mine is now being opened, No. 2 shaft being sunk to 155 ft. depth. From this point a cross-cut will be driven to the Tough-Oakes mine.

The Dome Lake Mining & Milling Company in 1917 treated 16,388 tons of $4.16 ore. There was extracted $2.75 per ton. Costs totaled $8.14, leaving a loss of $5.39 per ton. Ore-reserves are estimated as worth $57,492. Diamond-drilling indicates better ore, and the mill can now treat 150 tons per day.

Porcupine.—Good ore has been opened on 500-ft. level of the Dome Lake mine, better than in other parts of the property.

The McIntyre Porcupine property continues to open well. Results of the two half-years of 1917 compare as under:

Period	Tons	Value	Cost	Profit
First	86,086	$10.46	$4.94	$4.87
Second	89,807	10.48	5.04	4.58

Newray company's shares held by Crown Reserve and Dominion Reduction companies are said to have been sold.

Dome Lake mill when finished is to treat ore from West Dome Consolidated. For a start, 1000 tons is to be tested.

Davidson Mining Co. reports for 1917 that development totaled 3096 ft., also 2115 ft. of diamond-drilling, costing $83,000. Reserves are given as 100,000 tons of $10 ore down to 300 ft., while drilling revealed 35 ft. of ore at depth of 500 ft. Sixty-ton mill is ready for treatment.

KOREA

Unsan.—Oriental Consolidated Mining Co.'s clean-up for February was valued at $124,255. In January, 25,377 tons of ore yielded $126,006, of which $32,196 was net profit.

PERU

La Fundicion.—Cerro de Pasco continues to operate at full capacity. Its second hydro-electric plant was recently completed at Pachachaca, on line of Ferrocarril Central del Peru. It consists of a 3500-kw. Allis-Chalmers 2300-volt generator, driven at 300 r.p.m. by a tangential-type water-wheel under head of 790 ft. Water comes from lakes 14,000 ft. above sea-level, passing through a regulating reservoir, 9100 ft. of 48-in. wood-stave pipe, and 2640 ft. of steel pipe tapering from 48 to 32 in. Nozzles are 6 in. diameter. Discharge water is to be used again at the other power-plant at Oroya, 20 kilometres distant. Total capacity of installations is now 20,000 hp., transmitted over 189 miles of cables. Cerro de Pasco Mining Co. is completing plans for the addition of a new 400-ton unit to its mill. This will consist of primary rock-breakers and picking-belts for segregation of high-grade ore and fine to be sent to the smelter. The rejected coarse material from the picking-belts will be sent to a plant consisting of secondary crushers, rolls, and ball-mills. The crushed and coarser fine sand will be concentrated on tables, and the finer materials treated in a flotation plant.

Lima.—National Mining Congress sat here during third week of January. It was decided to make known the mineral resources of the Republic, to stimulate investment of foreign capital. More railroad construction was urged to develop the mineral areas. Cerro de Pasco, Backus y Johnson, and International Petroleum companies employ over 13,000 people in Peru, and contribute a total of Lp. 480,000 (1 libra = $4.87) per annum to the customs department.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Charles Janin has gone to Washington.

George C. Stone has gone to Australia.

L. S. Austin is at San Pedro, California.

Samuel H. Dolbear has returned to San Francisco.

F. L. Sizer is at Alleghany, Sierra county, California.

Benjamin Wilson, of Bisbee, Arizona, has gone to Peru.

Walter M. Stephen is at the Mamie mine, Hadley, Alaska.

F. W. Bradley was at the Atolia tungsten mines last week.

E. Gybbon Spilsbury has returned from Cuba to New York.

R. J. Glendinning, of Salt Lake City, was in San Francisco during the week.

R. S. Baverstock is examining strontium deposits in the Barstow district of California.

S. L. Pearce of Los Angeles, is going to Alamos, Sonora, as manager of the Promontorio mine.

Alfred R. Whitman has removed his office to 43 Exchange Place, New York, from Cobalt, Ontario.

Douglas A. Mutch has been appointed manager of the Dome Lake mine at Porcupine, Ontario.

C. H. James has been appointed consulting engineer for the Mazatzal Mining Co., of Payson, Arizona.

S. L. Pearce, of Los Angeles, California, is going to Alamos, Sonora, as manager of the Promontorio mine.

D. J. Coffey, of Porcupine, has been appointed general manager of the Lake Shore mine at Kirkland Lake, Ontario.

E. M. Hamilton, of Hamilton, Beauchamp & Woodworth, has gone to Pachuca, Mexico, where he will remain for several months.

Leroy A. Palmer has resigned as mineral examiner, U. S. General Land Office, to take a position as field engineer with the Suffern Company.

Edward Scallon, lately in Minnesota, has accepted the position of superintendent of the United Verde Extension mine at Jerome, Arizona.

W. J. Richards, head of iron mining interests at Crystal Falls, Michigan, has returned from the South, where he has been spending the winter.

Charles B. Croner, of Pasadena, California, recently examined a number of properties near Grants Pass, Oregon; also in Mariposa county, California.

Herman Garlichs, of Brooklyn, N. Y., has gone to British Columbia and the Pacific Coast to investigate sundry metallurgical problems in the North-West.

Charles Briggs, president of the Calumet & Arizona Mining Co., is expected at Calumet, Michigan, on May 15 from California, where he has been spending a few months.

H. A. Morrison has been appointed superintendent of the lead-silver mine of the Louisiana Consolidated Mining Co., at Tybo, Nevada, in place of **A. J. Canavan**, who has resigned.

John A. Traylor has resigned his position as Western manager for the Traylor Engineering & Manufacturing Co., but is retaining the general Western agency of the Cement Gun Co. He will devote most of his time to his mining interests, with headquarters at the Newhouse Bdg., Salt Lake City.

William Wraith, general manager for the International Smelting Co., was elected chairman of the Utah section of the A. I. M. E. last week. **Cecil Fitch** was elected vice-chairman, and **F. G. Moses**, secretary. These, with **E. R. Zalinski** and **Ernest Gayford** complete the executive committee.

H. Kenyon Burch, formerly consulting engineer to the Inspiration and Miami copper companies, has been appointed consulting engineer, in the concentrating department, to the Phelps-Dodge Corporation, and is now in charge of the design and construction of the 3000-ton concentrator of the Copper Queen Consolidated at Bisbee, Arizona.

Obituary

Harold W. Webster, Major in the Royal Engineers and son of Mr. W. W. Webster, a director of Minerals Separation Ltd., was killed on the Somme battlefield. He was a young man of much promise and had many friends in the profession.

David Keith died at Salt Lake City on April 16 at the age of 71. He was born at Mabou, on Cape Breton island, Nova Scotia, and early obtained an insight into mining by working in the small mines near his home. Of an energetic and adventurous character, he was readily attracted by the stories of gold discovery in California; as soon as he was old enough he shipped before the mast from a port in Maine to the Isthmus of Panama, eventually reaching California, where he heard the story of the Comstock and tramped across country from Sacramento to Gold Hill, Nevada. He began to work as a miner, becoming foreman at the Caledonia and Overman mines, and later manager of the Mexican. In 1882 he went to Park City, Utah, as foreman of the Ontario mine, then controlled by George Hearst and associates. He won a reputation for ability and in 1885 was appointed superintendent for the Anchor, now the Judge, mining company. He became associated with Thomas Kearns, John Judge, E. P. Ferry, and A. B. Emery in operating the Mayflower claims at Park City. This property became the celebrated Silver King mine, which made Mr. Keith a millionaire. At the time of his death he was president of the Silver King Coalition Mines Co. and he had many interests besides, in mines, banks, and railways.

SAN FRANCISCO SECTION A. I. M. E.

The next meeting of the local section of the American Institute of Mining Engineers will be held on Tuesday, May 7, at the Engineers Club, 57 Post street. The dinner ($1) will be at 6 p.m. and the meeting at 7. Professor C. F. Tolman will give a paper on 'The Ore Deposits of California.'

Two mining engineers are desired to fill vacancies in the Bureau of Mines. These will be Civil Service appointments, made on a competitive basis, but no examinations will be held. Instead of that proofs of rating in the educational institutions from which applicants graduated must be submitted, together with an original essay on some mining problem. The salaries range from $1200 to $1500 per year. Applications must be filed with the Civil Service Commission not later than May 14.

The National Electric Light Association, at a meeting of the convention committee, Walter Neumuller, chairman, voted to recommend to the Association that the annual meeting, devoted entirely to war problems, be held at Atlantic City, June 13 and 14, with the Hotel Traymore as headquarters. President Lieb has decided accordingly. The essential requirement is the limitation of the work of the meeting to the consideration of pressing and vital war problems as related to the industry. The secretary is T. C. Martin, 29 West 39th street, New York.

The American Electrochemical Society holds its spring meeting and Southern trip during the period April 28 to May 5. The party leaves Washington on the first day, visiting chemical works at Kingsport and zinc mills at Knoxville, North Carolina; chemical works at Chattanooga, Tennessee; construction of nitrate plant at Muscle Shoals, steelworks at Birmingham, and electric furnaces at Anniston, Alabama.

THE METAL MARKET



METAL PRICES

San Francisco, April 23

Aluminum-dust, large and small lots, cents per lb	65—70
Antimony (wholesale) cents per pound	13¼
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7¼— 8¼
Platinum, pure and with 10% iridium, per ounce	$108—$116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	10
Zinc-dust, cents per pound	17½

ORE PRICES

San Francisco, April 23

Antimony, 45% metal, per unit	$1.10
Chrome, 38% and over, f.o.b. Cal., per unit	$1.25— 1.50
Magnesite, crude, per ton	$7.00— 8.00
Manganese, 40 to 50%, Hazen, Nevada, cents per unit	92—110
Manganese, 48%, New York, cents per unit	$1.20
Tungsten, 60% WO_3, per unit	$20— 24
Molybdenite, per lb., 85% MoS_2	$1.80
Pyrite, domestic, New York, per unit of sulphur, cents	28

Chrome production and distribution was recently discussed in a contemporary by Samuel H. Dolbear of San Francisco. He said that one of the problems confronting America was that of increasing domestic supplies of chrome. Last year's output fell off 6000 tons. Deposits near rail were exhausted. Remote deposits can be made available with Government roads. Low-grade ore must be concentrated. Irresponsible brokers have been a burden on the industry. Sampling and settlement of shipments should be standardized. Suggestions as to the remedy are as follows: Place all chrome operations under Government control through license and inspection; provide, without charge, engineering advice to chrome miners; provide financial assistance to chrome concentrating enterprises, and require that construction and operation be supervised by engineers approved by the War Industries Board; prohibit brokerage and speculative transactions in chrome ore and license sale and purchase; and furnish cars promptly, with preferential movement when loaded.

EASTERN METAL MARKET

(By wire from New York)

April 23.—Copper is unchanged. Lead is quiet and easy. Spelter is inactive but steady.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67c. for small lots, effective until June 1, 1918. Quotations in cents per pound are as under:

Date		Average week ending	
Apr. 17	23.50	Mch. 12	23.50
" 18	23.50	" 19	23.50
" 19	23.50	" 26	23.50
" 20	23.50	Apr. 2	23.50
" 21 Sunday		" 9	23.50
" 22	23.50	" 16	23.50
" 23	23.50	" 23	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	....	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Copper production of some of the large mines in March was as under:

Mine	Pounds
Calumet & Hecla and subsidiaries	13,784,569
Chile	10,192,000
Chino	7,833,046
Granby	3,807,600
Nevada Consolidated	6,060,000
Ray Consolidated	7,585,000
Utah	16,380,000

SILVER

Below are given official or 'ticker' quotations, in cents per ounce of silver 999 fine. The actual figure at which the metal is bought and sold is a matter of negotiation, and is not available, but the prices given indicate such approximately. Premiums are paid, up to 3c. per oz. See 'M. and S. P.' of March 23, 1918, for full details.

Date	New York, cents	London, pence	Average week ending	
Apr. 17	95.62	47.25	Mch. 12	85.66
" 18	95.62	47.25	" 19	86.71
" 19	96.62	47.75	" 26	91.27
" 20	97.75	48.25	Apr. 2	92.12
" 21 Sunday			" 9	91.74
" 22	99.25	49.00	" 16	93.73
" 23	99.25	49.00	" 23	97.35

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	....	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

The silver bill passed the Senate on April 18, and the House on the 22nd. When it is signed by the President, $1 per oz. will be the fixed price.

During 10 years the Crown-Reserve Mining Co. at Cobalt, Ontario, produced nearly 20,000,000 oz. of silver at the following cost:

Year	Production ounces	Price received cents	Cost per oz., cents
1908	1,798,954	50.64	7.50
1909	4,034,325	51.56	10.31
1910	3,248,196	54.10	11.97
1911	3,430,902	53.46	10.67
1912	2,714,766	62.32	14.02
1913	1,776,678	59.45	23.02
1914	1,425,320	51.92	28.95
1915	657,395	52.40	45.01
1916	274,470	70.40	69.30
1917	329,670	80.63	65.60
Total and averages	19,690,676	55.22	16.40

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date		Average week ending	
Apr. 17	6.95	Mch. 12	7.25
" 18	6.95	" 19	7.25
" 19	6.95	" 26	7.25
" 20	6.95	Apr. 2	7.19
" 21 Sunday		" 9	7.13
" 22	6.95	" 16	7.00
" 23	6.95	" 23	6.95

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	....	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

The War Industries Board on April 6 reached an agreement with lead producers whereby they will furnish all Government requirements for lead products—6,000,000 lb. minimum and 12,000,000 lb. maximum per month—at prices averaging 7c. per pound. The maximum requirement of 12,000,000 lb. per month for the Government is 20% of the entire lead output of the country. No priority orders for delivery therefore will be necessary, the Board announced, unless transportation conditions should affect delivery of the Government orders. This remains in effect for four months.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound.

Date		Average week ending	
Apr. 17	7.00	Mch. 12	7.79
" 18	7.00	" 19	7.75
" 19	7.00	" 26	7.56
" 20	7.00	Apr. 2	7.33
" 21 Sunday		" 9	7.23
" 22	7.00	" 16	7.00
" 23	7.00	" 23	7.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	....	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. Prices, in dollars per flask of 75 pounds:

Date			
Mch. 26	115.00	Apr. 9	115.00
Apr. 2	105.00	" 16	115.00
		" 23	115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	....	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	....	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Tin amounting to 15,042 bars, valued at $1,500,000, arrived at San Francisco from the Orient on April 22.

Eastern Metal Market

New York, April 17.

The markets are inactive and nearly featureless. The metals that lately have been weak now have declined slightly.

Copper is unchanged and devoid of developments.

Tin is less active and at a standstill, pending important developments at Washington.

Lead is very quiet, and a little lower.

Zinc is dull, and has declined further.

Antimony is unchanged.

In the steel industry plate mills have shown remarkable outputs, more than 110,000 tons having been the production in one week of April. Charles M. Schwab, chairman of the board of the Bethlehem Steel Corporation, has been made director-general of the Emergency Fleet Corporation; this will probably mean a further speeding of effort. Definite moves will be made this week on the project for the greatest American gun plant, which the Government and the U. S. Steel Corporation will build in co-operation, the latter erecting the steel works. It will probably be in the Pittsburgh district, and will include a great projectile plant. The largest machine-shop in the country will be provided.

COPPER

The market is without important developments, and price changes are impossible under present conditions and Government control. A trade journalist of high authority states: "In the counting-rooms the continued tardiness of the Government in making settlements creates financial embarrassments. The Government is said to owe the copper producers something like $16,000,000." Verification of this has been attempted, but without success. Its probability is vouched for in the trade as judged by the experience of other industries. Reports of the March output of miscellaneous companies continues to indicate a considerable expansion, and tend to encourage the belief that the output will exceed 200,000,000 lb. per month in the near future. Refining costs are mounting and are causing considerable uneasiness. It is also stated that some of the small producers have formed a committee to present their grievances as to the growing costs and small profits at Washington. Government prices of 23.50c. for carloads, and 24.67½c. for less, continue to control distribution, which is regulated by the Copper Producers' Committee, who seem to be giving satisfaction to all concerned.

TIN

The situation is as unsatisfactory as ever. Offerings from the other side are now almost nil, and, as a consequence, business has been light. Buyers also are not as anxious to purchase as they were, but the few offerings that have been made have brought out extraordinarily high prices. The change in the attitude of buyers is thought to be due to certain happenings at Washington, but reports as to just what is going on there are conflicting. Consumers have been called to Washington this week, and each day meetings are being held between the Government and the various branches of the consuming trade. It is rumored that the object is a discussion of means to conserve the supply of tin, but many believe that there is something more radical than this back of the matter. Until this is entirely cleared, the market will probably remain quiet, and eagerness to buy will gradually subside. For spot tin the quotation now is 87c., New York, which represents what it would be sold for under fair or reasonable conditions. An interesting news item is that a representative of a South American tin refiner has appeared in New York and says that he has 100 to 150 tons of tin on the way to this country, assaying 99.86% tin, and that there will soon be available 500 tons per month. Arrivals to date total 265 tons, with 5000 tons estimated as afloat. The London market is higher, with spot Straits quoted at £323 10s. against £319 10s. a week ago.

LEAD

The only event of the week that had any bearing on a rather lifeless market was the reduction last Thursday, April 11, of the quotation of the American Smelting & Refining Co. to 7c., New York, from 7.25c., which had obtained for some time. The outside market has also declined as a result to 6.95c., New York, or 6.80c., St. Louis. Very little business is reported at any price. The market seems to have before it a little more lead than it can absorb at present, and the situation is a narrow and restricted one, with the tone easy. The position of the large producers is unchanged. The large independent producer, the St. Joseph Lead Co., is still shut-down because of labor troubles. It has been closed now for four weeks. This lessens the offerings of lead considerably. Spot lead is quoted at 7 to 7.12½c., New York.

ZINC

For a time at least the market seems to have reached its low level. Opinion is divided as to whether or not it will go lower. There is not much expectation of an advance for some time. Prime Western for early delivery is lower than last week, the quotation being 7c., New York, or 6.75c., St. Louis. Sales have been made at 6.80c., St. Louis, for April-May delivery, and at 6.87½c., St. Louis, for May-June-July delivery. These about represent the market for the past five or six days. Demand is only fair, and sales have not been large, though each day lots of 100 tons have changed hands. The reports on stocks and output for the first quarter of this year show a slight increase in stocks on March 31 as compared with December 31, 1917, or 64,000 tons against 60,000 tons. The rate of production has not declined as much as expected.

Sheet zinc is officially fixed at 15c. per pound.

ANTIMONY

Demand is of small proportions, even that of the Government not being large. The quotation for Chinese and Japanese grades, duty paid, New York, is unchanged at 12.75 to 13c., New York, for prompt and early delivery.

ALUMINUM

For No. 1 virgin metal, 98 to 99% pure, in lots of 50 tons, 32c. per lb. is the Government price, with 32.10c. fixed for 15 to 50-ton lots, and 32.20c. for 1 to 14 tons, all for prompt or early delivery.

ORES

Antimony: A little business is reported done at $1.75 per unit, New York.

Manganese: The U. S. collier 'Cyclops', which has evidently been lost, carried a large cargo of manganese ore from Brazil. A scarcity of ore suitable for making manganese alloys, no matter what the standard, is predicted in the trade to be certain within three to four months. It is believed that domestic-ore interests cannot deliver the quantity promised the Government. This is based on work done so far in the past.

Molybdenum: Business is difficult because molybdenite has been placed on the conservative list. The quotation is nominal at $1.80 per lb. of MoS_2 in 90% concentrate.

Tungsten: Prices are unchanged at $24 to $24.50 per unit in 60% concentrate with activity somewhat less than for a week or two. Ferro-tungsten is unchanged at $2.25 to $2.40 per lb. of contained tungsten, with the market quiet.

Company Reports

PREMIER (TRANSVAAL) DIAMOND MINING CO., LTD.

Property: diamond mines and works near Pretoria, Transvaal, South Africa.

Financial Statement: profit during the year ended October 31, 1917, was £800,919 ($3,845,000), and balance for distribution to the Union government (60%) and company (40%) was £757,046 ($3,633,000).

Development: the 410-ft. level is being opened. Average depth of open-cut working is 249 ft. Reserves of diamondiferous ground above 360-ft. level are 27,000,000 loads (1600 pounds).

Production: 5,080,232 loads of 16 cu. ft. each, yielding 0.184 carat per load, or a total of 906,341 carats.

Costs: on a per-load basis, 50 cents; on a per-carat basis, $2.72.

Natives employed numbered 5751, who were paid 74 cents per day; and whites 440, who received an average of £304 ($1440) per annum.

IRON SILVER MINING CO.

Property: mines at Leadville, Colorado.

Operating Official: George O. Argall, general manager.

Financial Statement: total income was $326,109 in 1917, of which $293,889 was from ore sold. Operations cost $269,698, plus $14,838 special expenses. Excess of income over operating charges was $41,574, less equipment depreciation $20,106. The depletion charge of $21,468 left no profit for the year. Surplus at beginning of year was $368,187, and at end $268,187.

Dividends: two paid last year absorbed $100,000.

Development: total new work covered 7626 ft. Results failed to reveal the presence of additional ore in the older mines. The Moyer was worked out, while the Tucson is approaching that point. The new Marian mine is likely to be a good producer. The Mikado shaft here was enlarged to 15 by 5 ft. from 1000-ft. level to 1135 ft. Stations were cut at 1000, 1075, and 1125 ft., and pumps installed at the shaft-bottom. On the 1000-ft. level a large body of medium-grade zinc sulphide was cut. To further develop contiguous ground, a 5-year lease was taken on the Alleghany property of 19 acres. Lessees produced 25% of the ore.

Production: zinc-lead sulphide, zinc sulphide, iron oxide and sulphide, copper sulphide, zinc and lead carbonates, and manganese ores mined totaled 40,074 tons. This yielded as follows:

Metal	Quantity
Gold, ounces	689
Silver, ounces	163,493
Lead, pounds	1,893,020
Zinc, pounds	13,342,256
Copper, pounds	26,914
Iron and manganese, pounds	5,956,671

NORTH STAR MINES CO.

Property: gold mines and mills at Grass Valley and Nevada City, California.

Operating Officials: A. B. Foote, general superintendent.

Financial Statement: during 1917 gold extracted was sold for $1,337,014. Interest, etc., amounted to $37,410. Operations cost $720,424 at the North Star and $240,045 at the Champion, plus $61,582 for improvements. Property purchase cost $31,401. Balance at end of 1916 was $910,864, and carried forward to 1918, $979,836. This is mostly cash and investments, including $250,000 of Liberty Bonds.

Dividends: two of 10% equalled $250,000, making $5,337,040 to date.

Development: the North Star production came chiefly from stopes above the 3000, 3400, and 4400-ft. levels. New openings covered 3216 ft. Nothing was done below 4400 ft. depth. Results were generally satisfactory, reserves being maintained. Of the ore broken, 25,974 tons was waste.

Results obtained or indicated prospects at the Champion are not very encouraging. Most of the ore came from the 2700-ft. level. New work amounted to 2495 feet.

Production: this was as under:

Mine	Tons	Value per ton
North Star	100,500	$11.43
Champion	41,650	4.52

Of the total gold extracted, 82.06% was by amalgamation and 17.94% by cyanidation; this is at the North Star. Residue is estimated at 40c. per ton.

Costs: these were $1.15 per ton higher than in 1916. The main items in the total of $7.188 were $4.629 for mining, 61.1c. for milling, 45.8c. for cyaniding, and 53.5c. for development.

The Central mill and cyanide plant were re-arranged, and now includes sixty 1500-lb. stamps and treatment section doing the work formerly done by two 40-stamp mills and separate cyanide plants. Capacity is expected to reach 9000 tons per month.

BINGHAM MINES CO.

Property: Dalton & Lark mines in West Mountain district, Salt Lake county; Victoria mine, Tintic district; Eagle & Blue Bell mine in Tintic district; and Yosemite mine in West Mountain district, all in Utah.

Operating Officials: Imer Pett, general manager; William Owens, superintendent of Eagle & Blue Bell; Joseph Hyland, superintendent of the Bingham properties.

Financial Statement: net earnings of Dalton & Lark mines, and royalties, amounted to $150,015; plus dividends on shares of Eagle & Blue Bell and Victoria, $365,788, making a total of $515,802 for 1917. In 1916 the net income was only $185,760, and in 1915, $197,923. Construction and mine depletion reduced the 1917 income to $431,303. Surplus at end of 1916 was $400,224, and at end of 1917, $644,028.

Dividends: two, No. 1 and 2, amounted to $187,500.

Development: in the Dalton & Lark group, new work totaled 3670 ft. The Brooklyn mine shows a productive vein above the Mascotte tunnel for 800 ft. in length, extending to 1600-ft. level, a distance of 400 ft. on the dip of the beds. This is copper and lead ore. General results were good.

In the Victoria mine, operated through the Eagle & Blue Bell No. 1 shaft, the best results were in workings above 1050-ft. level at south end of property. Considerable lead-silver and dry silicious ores were opened between 1200 and 1300 ft. depth.

Exploration in the Yosemite mine was disappointing.

New openings in the Eagle & Blue Bell mine amounted to 4783 ft. Many new discoveries of ore were made, some of which are small and of low grade, but are promising. Production from the 1550-ft. level proved this section to be the best in the mine.

Production:	Dalton & Lark	Victoria	Yosemite	Eagle & Blue Bell
Ore shipped, dry tons	25,776	13,543	839	34,457
Gross value	$334,668	$343,909	$13,227	$1,068,837
Gold, ounces	1,872	2,875	36	2,819
Silver, ounces	139,241	338,751	5,047	519,880
Copper, pounds	679,007	119,553	11,005	4,089
Lead, pounds	1,681,848	515,993	121,776	9,069,091
Net profit	$150,015	$144,933	.....	$491,807

Book Reviews

Metallurgical Calculations. By Joseph W. Richards. Pp. 675, index. McGraw-Hill Book Co., New York, 1918. For sale by 'Mining and Scientific Press.' Price, $5.

A one-volume edition of Dr. Richards' well-known book is before us, bearing the imprint 1918. The old text has been carefully revised and corrected, and useful physical and chemical data have been added. New features consist in tables of thermo-chemical constants for assisting in the prediction of undetermined heats of formation, the estimation of many latent heats of fusion and vaporization of the elements useful provisionally as first approximations, and the evaluation of vapor-tension formulas for the elements in both liquid and solid states. The work is a standard for all students of metallurgy, and this new and revised edition, condensed into a single volume, will be extremely welcome.

The Chemist's Pocket Manual. By Richard K. Meade. 3rd edition. Pp. 530. The Chemical Publishing Co., Easton, Pa., 1918. For sale by 'Mining and Scientific Press.' Price, $3.50.

The third edition of this well-known and exceedingly useful vade mecum for the chemist contains important additions applying to problems connected with chemical engineering, a branch of technology that has developed so rapidly in this country within the last three years, and there has also been a large extension of the treatment previously given to analytical chemistry, so that the book has now become two and a half times as large as when it originally appeared. The increase over the second edition is 87 pages; these bear especially upon the needs of chemical industry as developed under the spur of war. The book has taken its place in the affections of the chemical student, and this new edition will prove of even greater value than the earlier editions.

Chemical Annual. Fourth issue, revised and enlarged. Edited by John C. Olsen and M. P. Matthias. Pp. 686, index. D. Van Nostrand Co., New York, 1918. For sale by 'Mining and Scientific Press.' Price, $3.

It is four years since the previous edition of this handbook was published. During that period there have been many additions to the science of chemistry, and this work has been brought up to date. Molecular weights and factors have been re-calculated, and physical constants of the chemical elements and compounds (240 pages) revised. New tables include those on properties of the elements, calibration and true volume of glass vessels, use of indicators, properties of oils, alloys, etc., specific-gravity tables, and the conversion of units of heat, electricity, and temperature. In the tables on physical constants of oils there is nothing on those oils used in flotation processes. A note on the chemists duplex slide-rule is of value, so are the problems in acid and gas calculations. The insertion of 93 pages, listing new books, between the subject-matter and index is not a good idea. However, the handbook will be found of considerable value.

American Lubricants. From the standpoint of the consumer. By L. B. Lockhart. Pp. 236, ill., index. The Chemical Publishing Co., Easton, Pa., 1918. For sale by 'Mining and Scientific Press.' Price, $2.

The present war has been termed as one of applied science, in which gasoline and lubricants play extremely important parts. Lubrication of rapid or slowly-moving machinery requires more skill than is generally supposed, whether it be a watch, 10,000-kw. turbo-generator, or planing-machine. It is essential that an engineer know the grade of oil he is using, its viscous nature, also from what base oil it was made. In this book he will find such matters discussed practically; also many tests on a variety of lubricants. Grease is used in increasing amounts for lubricating heavy machinery, also even for moderate-speed shafting and inaccessible parts. Graphite and mica are often mixed with grease to advantage. Animal and vegetal oils find a place in many plants, and are described. With the enormous expansion in the use of automobiles and internal-combustion engines, lubrication requires much study, but in this case the consumer of oil need not bother much, as the manufacturer has designed the system to take care of the high temperatures produced. Lubrication of electrical machinery, steam engines and locomotives, cotton mills, and the like, receive due consideration. Stress is laid on the fact that railroad and power-plant companies, which allow a fixed quantity of lubricants for the machines in use, make a costly mistake in so doing, as often their engine-men need oil badly and cannot get any. Seven short chapters on specifications for oils, and various tables conclude a book for every consumer of lubricants.

Official Year Book of the Commonwealth of Australia. Statistics for period 1910-1916. No. 10, 1917. Compiled by G. H. Knibbs. Pp. 1198, charts, maps, index. McCarron, Bird & Co., printers, Melbourne.

This interesting compilation covers everything pertaining to Australia, including its history to the part being taken in the War. With the tabulated matter is much readable explanation. The graphs showing progress in certain industries are instructive. Under the head of 'Mines and Mining' we find 50 pages. Gold shows a serious decline since 1903—£16,294,684 to £6,200,000 in 1917— and a decrease in all minerals from 1907 to 1909, a small gain to 1913, then another drop to the present time. There are about 70,000 men engaged in mining, against 113,000 in 1901. Australia is an important producer of tin—lodes, hydraulicking, and dredging—also of bismuth, chrome, molybdenite, and tungsten, in addition to the common metals. Oil-shale being so prominent in the United States at present, it is interesting to note that immense deposits occur in New South Wales and Tasmania, but are not worked to any extent just now. Two special papers deal with eucalyptus timbers and oils, giving some interesting notes on the oils extracted and used for flotation purposes. All flotation is done in Australia by eucalyptus oil. The iron industry of the Commonwealth shows a gratifying growth. Government aid to mining in 1915 amounted to £120,000 ($600,000).

Elements of Western Water Law (revised). By A. E. Chandler. Pp. 162, index. Technical Publishing Co., San Francisco, 1918. Price, $2.50.

The author is president of the California State Water Commission, and of the California Irrigation Board, and is a well-known irrigation and water-right specialist. The book will be useful to all users of water for mining and metallurgical purposes, as well as for agriculture throughout the West, where water-rights are subject to conditions that have grown out of ancient usage in dry countries, where scarcity has necessitated the application of utilitarian rules quite unlike anything to be found in well-watered regions. The book discusses the early development of the doctrine of appropriation, riparian rights in the Western States, the law of underground waters, the doctrine of appropriation, loss of water rights, and then takes up water-right legislation, bases of commercial and co-operative irrigation enterprises, the acts known as the 'Desert Land', the 'Carey', and the 'Reclamation', together with

other matter of interest. It is well indexed, and is paragraphed in such manner as to make the data easily accessible for use as a manual.

Everyman's Chemistry: The Chemist's Point of View and his Recent Work Told for the Layman. By Ellwood Hendrick. Pp. 374, index, bibliography. Harper & Brothers, New York, 1917. For sale by 'Mining and Scientific Press.' Price, $2.

The popular scientific treatises by Mr. Hendrick are well known. They have been justly accepted by the public with the enthusiasm that the public always displays toward scientific subjects when presented clearly and brilliantly, couched in simple terms, and emanating from a person that can speak with authority. The book is thoroughly scientific in the sense that the development of the subject is along scientific lines. A man knowing no more chemistry than is contained in this book would have a very broad outlook upon the constitution of the world in which he lives, and he would better appreciate the complexities of modern industrial life and the needs of the Nation in stimulating and maintaining production of the many important essentials in War as it is conducted today. This is in no sense a war book, but its bearing upon the struggle should be very great, because it will help men who are not familiar with chemistry to obtain a grasp of the chemical bases of modern industrial life. The volume discusses air and water, the halogens, sulphur and its compounds, phosphorus, arsenic, antimony, bismuth, the alkali metals, sand and clay, lime and magnesia, iron and steel, and many metals both common and rare. With special facility the author undertakes to elucidate the principles of organic chemistry, starting with the carbon molecule and the simple hydrocarbon CH_4, from which he develops correctly the modifications that lead to the vastly complicated products of which there is no end. He promptly, however, comes to the practical application of organic chemistry in the discussion of olefins and acids, alcohol and some of its derivatives, fats, oils, sugar, starch, and gums. Cellulose and nitrogen compounds, the aromatic compounds, and the coal-tar derivatives constitute the remainder of the book, with the exception of some valuable appendices. In this discussion the author reveals the chemistry of the common things of life, such as industrial alcohol, soaps and their uses, cane and beet sugar, gums, varnishes, paints, bread-making, explosives, artificial silk, paper, benzol, picric acid and aromatics, and dyes. Any man with an ordinary high-school education will be able to read the book, and it is so delightfully written that it is a pleasure to read it. We would suggest that the technical men who happen to be identified with operations involving organic chemistry would find it a most useful and delightful means for reviewing the subject in the light of modern manufacture.

Victory Breads. 50 bread recipes; 50 practical suggestions; 50 economical dishes; for 50 cents. Compiled by Helen Rickard. Press of the W. H. Kistler Stationary Co., Denver, Colorado, 1918.

One of America's famous mining engineers has said that the world's three great cook-books were written by members of that profession. A new contribution to the cuisine literature of the War, 'Victory Breads', issues from Denver, Colorado, compiled by Helen Rickard, wife of a mining engineer. The volume is dedicated to Mrs. Thomas Beale Stearns, wife of the Food Administrator in Colorado. The initial recipe, 'Cornbread with No Wheat Flour', is from the scholarly pen of Mrs. Herbert C. Hoover, also the wife of a mining engineer. The other recipes are contributed by women whose names have more than a local significance. One of America's distinguished chemists recently stated that the fact of the kitchen having been under the rule of woman since Garden-of-Eden days, and no great discovery having issued therefrom, proves the inferiority of the feminine brain. Now that women have begun to study chemistry, there is hope that this stigma may be removed from that portion of the race to whose hands has been entrusted the important duty of supervising the nourishment of the family. Meantime 'Victory Breads' points out how the women of America may help, in the fateful struggle in which our country is engaged, by "intelligent, earnest, and persistent food conservation." This duty will be made more simple by frequent consultation of this booklet of dependable recipes sent forth by patriotic women for the benefit of the American Red Cross. The suggestions given will be of genuine assistance in complying with the mandates of the Food Administration and with the dictates of one's conscience, a help toward getting back to essentials; not the simple life of the man "wearing sandals and simple raiment, a raw tomato held firmly in his right hand", to which Chesterton jestingly refers, but to the practical wholesome fare to which thoughtful persons conform in order that those who are offering their lives for our freedom may have the food necessary to their sustenance. Let us pray: "Give them this day their daily bread", and let us relinquish it joyously to our defenders, nourishing ourselves with the substitutes—corn, on which the entire American continent depended (and it supported vigorous warriors by the thousands) until the coming of the European; oats, the national food of the hardy Scotchman; rice, the mainstay of the Japanese, a nation so warlike as to command world-wide respect; barley, a strength-giving food for both man and beast. All these cereals, with the addition of rye and emmer, we may use freely, sacrificing only wheat. Neither are we stinted in the use of potatoes, a tuber that has nourished a race so aggressive as that of the Emerald Isle. Indeed, our war diet would seem luxurious living in many countries. It recalls the priest in his poverty-stricken desert parish, who received from his bishop a printed list of foods he might use during the Lenten season. To compensate for lack of meat he might have fish, nuts, milk, chocolate, and many delicacies unknown to his frugal region, dainties that would have made a mockery of his fasting. With 50 war-bread recipes from which to choose, as offered by 'Victory Breads', the housewife will have no difficulty in maintaining variety. The practical advice, 'Learn to Use Beans', is followed by numerous recipes for their preparation. Among the Mexicans beans are known as the poor man's friend. They, with the corn tortilla, are literally the staff of life in the southern republic, and have been for ages. The plea for the use of the banana is sane. It plays an important part in the diet of the warm countries, and is one of the most nourishing and easily digested foods known to mankind. A remarkable menu is 'A Meatless, Wheatless, Heatless, Butterless, Sugarless Luncheon'. This title suggests a 'luncheonless luncheon', but it turns out to be a luncheon so dainty and satisfying that it may be considered a banquet by many citizens of our own United States, showing that not sacrifice but change is all that is asked by the Food Administration. If frugality be change, it will prove beneficial; groaning tables make groaning stomachs. The recipe, 'A Whole Dinner in One Dish' is so modest as to come within the limitations of the purse of any one who can afford to eat at all. The mother of many children will find useful the recipe for 'Everlasting Gingerbread'. To give it in this review would be to defeat the purpose of the volume. 'Victory Breads' closes with recipes for soaps, for white-wash, for baking-powder, for yeast, for preserving eggs, and finally with blank pages for your own original recipes. Buy it; you will find it useful to you, while the half-dollar will go to help save the life of some brave soldier. Copies can be secured from Mrs. Forbes Rickard, 950 Lafayette St., Denver, Colorado.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

TUNNEL DRIVING AT UNITED VERDE EXTENSION

By D. J. O'Rourke

*To simplify the present system of handling copper ore at its Audrey and Edith shafts, the United Verde Extension Mining Co. at Jerome, Arizona, is driving a tunnel 12,384 ft. long. At present, ore is carried 4000 ft. down the mountain by aerial tram to storage-bins on the railroad. From here it is hauled to custom smelters in Arizona. The company is erecting a smelter at its property, to be finished this year. The tunnel will save much re-handling of ore, also eliminate hoisting it 1100 ft. from No. 13 level of the main shaft. From the foot of this shaft the ore will be hauled

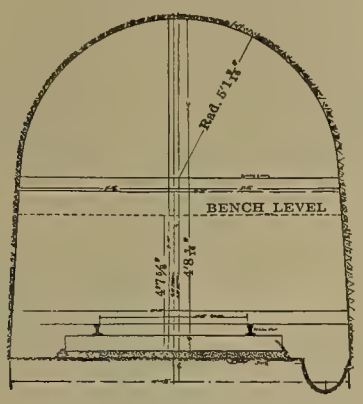


FIG. 1. CROSS-SECTION OF TUNNEL.

through the tunnel to the Arizona Extension railroad, on which the cars will carry it to the new smelter, three miles away.

The new thoroughfare is being driven from four headings, that is, from inside the mine, from the outside or portal end, and from both faces at the foot of the Texas shaft, sunk 613 ft. deep at a point 6700 ft. from the portal. The completed tunnel will be 9½ ft. clear above the track and 11 ft. wide at sub-grade. A ditch, 18 in. wide and 12 in. deep, is being dug at one side for drainage. Track will be laid with 70-lb. rails, and road-bed is to be sufficient for steel railroad hopper-bottom cars of 30-ton capacity. These are to be hauled by electric locomotive. The grade from the mine is 0.425%, or 22.5 ft. per mile. The Potter Construction Co. of St. Louis has the contract.

Rock at the portal end of the tunnel, and so far for 3600 ft., is conglomerate—a cemented mixture of sandstone, limestone, diorite, and malapai. Fragments vary from pebbles to pieces three feet in diameter. The whole is dense and tough. It carries no water. At the station end (at shaft) of the tunnel the rock was first diorite and schist, intruded by soft dikes, requiring heavy timbering—12 by 12-in. spaced 5-ft. centres.

*Abstract from 'Mine and Quarry,' February 1918.

Work was started at the portal on July 7, 1917, since when the following distances have been driven:

1917	Feet	1917	Feet
July	300	November	581
August	453	December	640
September	517	1918	
October	563	January	614

This gives a total of 3668 ft., or 524 ft. per month. As much as 25 ft. has been driven in 24 hours.

Considerable delay was encountered in making satisfactory progress in this ground at the start, due to difficulty in getting holes to depth in the formation. First method of drilling tried was by means of self-rotating hammer-drills, holding the machines by hand for some holes, while for others the drills were mounted on cradles and feed-screws on columns. Four drills were used in the heading at one time, and holes 8 to 10 ft. deep were drilled. Hexagon hollow steel—⅞-in.—was used with cross-bits. The drills were of the water-type, by means of which a water and air-jet was forced to the bottom of the drill-hole to clean it of cuttings. After driving 90 to 100 ft. with the rotators, it became evident that the use of mounted drills entirely would give better results on account of the difficulty in keeping the holes in line when running through the uneven formation. It was also decided to substitute heavier machines for the rotators, and the Sullivan DR-6 water-jet mounted hammer-drills, with 2½-in. cylinder, and weighing 150 lb., were adopted. For a considerable period the heading was advanced with two of these mounted on double-screw mining columns, the drills being carried by means of extension arms, enabling the drill to work 36 in. from the column in drilling the side-holes to follow the contour of the tunnel.

It was later decided to increase the depths of the holes from 10 to 13 ft. Six cut-holes are used. The solidity of the bonding is well shown by the fact that with the 13-ft. cut-holes, 7 or 8 ft. of the cut are often thrown out by the first shot in a practically solid mass of wedge shape, requiring re-blasting, before it can be sent away. The cut-holes are then loaded again, and re-shot before the side round is fired. If any of the cut is still left after the second shooting, it is again loaded and shot, with the side round. The explosive used in the cut-holes, which gives excellent satisfaction, is Atlas blasting gelatine of 60% strength. Atlas gelatine of 40% strength is used to blast the side rounds and roof-holes. The side round and roof holes are fired at the same time, delay exploders being used for the roof, which is thus thrown out after the side round has gone. No relieving holes are used, as it is found that the heavy charging of the cut-holes occasionally caused ignition of the charge in the relievers at times when seams were being crossed. Four rib-holes are put in on each side of the tunnel, four holes in the roof, and four lifters, making a total round of 22 holes. The roof and side-holes are of approximately the same depth as the cut-holes.

This tunnel is being driven; as indicated by Fig. 1, by the top-heading and bench method, the work being divided between a 7-ft. heading and a 3½-ft. bench. The bench is kept within about 30 ft. of the heading at all times, and is drilled

with Sullivan DP-33 water-tube rotator drills, using ⅞-in. hexagon hollow steel with cross-bits. Holes are drilled with these machines to a depth of about 5 ft. to insure reaching the sub-grade of the tunnel.

Telescopic bars or braces are placed across the tunnel, just above the grade of the bench, at a sufficient height to permit the tunnel cars to run below them. Planks are laid on these supports, serving as a runway for the barrows in which the shovelers remove the waste from the heading, and from which it is dumped into cars below. The tunnel is laid with double track of 12-lb. rail at the heading, the switch being moved forward every two weeks, and passing tracks are laid 1200 ft. apart. Steel side-dump cars of 32 cu. ft. capacity are employed for handling the rock. These are the same type and size of cars as those used on the Los Angeles aqueduct tunnel five or six years ago. Mules are used for haulage, the mules coming right up to the end of the scaffolding, which is within 30 or 40 ft. of the bench, so that practically no hand tramming is necessary. One mule hauls two cars at a time.

Two eight-hour shifts are worked. The shovelers, consisting of 12 and a foreman, commence work at 8 a.m. Three hours are required to load out rock from the previous shot at the face, so that when the miners start work at 11 o'clock they are able to set-up columns and start drilling the new round. Two men are used on each machine in the heading. Under favorable conditions the holes are completed by 3:30 or 4 o'clock. The round is then shot, so that ample time is allowed between shifts for blowing the smoke. Two rotators, each operated by a single man, drill the bench. The next, or night, shoveling shift comes on at 8 o'clock in the evening, and the miners again at 11.

As stated above, about 1350 ft. has been driven from the inside or station-end of the tunnel. The problem at this heading was not one of drilling speed, but of adapting the work and organization to operations in the mine. All waste from this heading has to be handled through the main hoisting shaft of the United Verde Extention mine, or carried back into empty stopes. The cars are handled by tail-rope haulage. Trouble was also experienced in blowing-out the tunnel after blasting, so that special means for ventilation had to be devised. Finally it became necessary to draw a fresh air-supply from the Edith shaft, on the 13th level, by means of 12-in. pipe, the exhaust system being used to suck air in from the Edith shaft by a No. 8 Buffalo blower.

Due to these conditions, and trouble in timbering, it was found that a rate of advance of between 5 and 6 ft. per shift was as great as proper disposal of the rock would allow. Fig. 2 shows the tunnel round in this heading, which is practically the same as that at the portal heading, except that relieving holes are used to secure better distribution of the powder and break up waste smaller. Two Sullivan DR-6 drills, mounted on extension arms on double-screw mining columns, are used in this heading, also for drilling the heading round. The bench is drilled by means of lifter or horizontal holes put in from a cross-bar by the heading crew after they have drilled the heading round. The DR-6 drills are mounted on a bar for this purpose, and 7-ft. holes are the rule. The bench is carried up to within a few feet of the heading, and all rock from the heading thrown over the bench. The material from both the heading and bench is loaded directly into mine-cars.

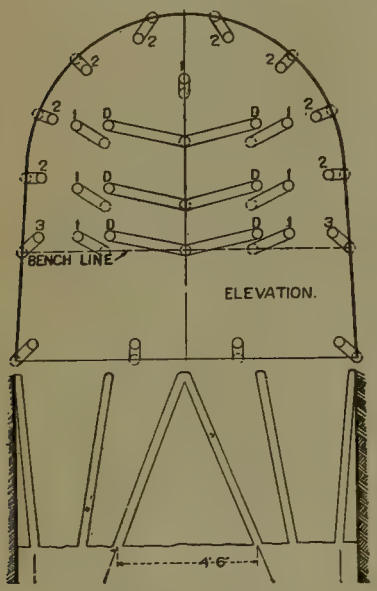
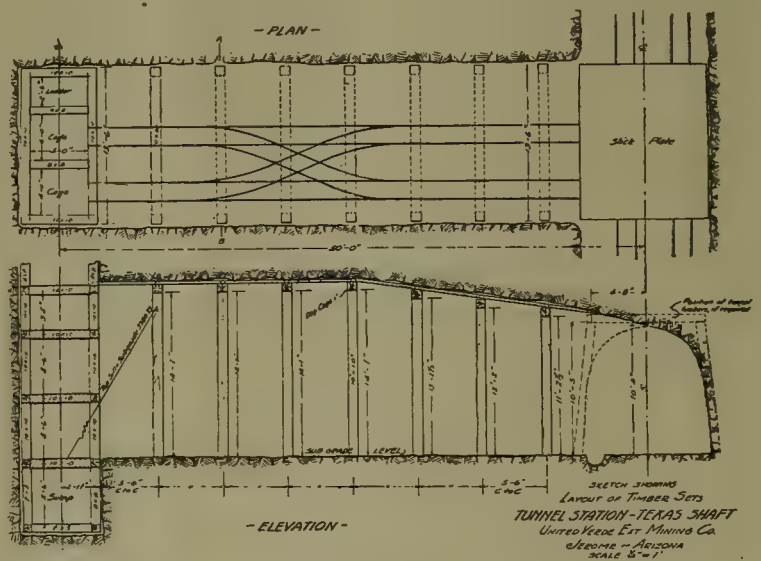


Fig. 2. Drill Round at Station Heading.



Plan and Section of Tunnel Station.

The bits are heated in a Denver Fire Clay Co.'s oil-forge, and are heated for tempering in the same furnace. The bits used are interesting, being of the four-point or cross-type, with low centre, and double taper on the wings. The wings, for a distance of one inch back from the face, have a 5° taper; with the usual 14° taper from that point to the base of the wing. In the tough conglomerate formation mentioned, this double taper gave a good reaming effect, as will be seen from the fact that it is seldom that a steel has to be changed on account of lost gauge before the end of the run is reached. The low-centre bits secure the advantage that holes rarely drift as they would otherwise do frequently, due to the different angles at which the boulders are encountered. The high corners catch the hole on the sloping surface of the boulder.

The Deister Concentrator Co., of Fort Wayne, Indiana, has issued for gratuitous distribution a large four-page map of the western battle-front from the North Sea to the Swiss border. It is an exceptionally clear and well-executed series of charts, giving all the towns involved in the zone of conflict. Every student of the great events taking place in the struggle against the Hun will appreciate this valuable aid in following the course of the contending armies.

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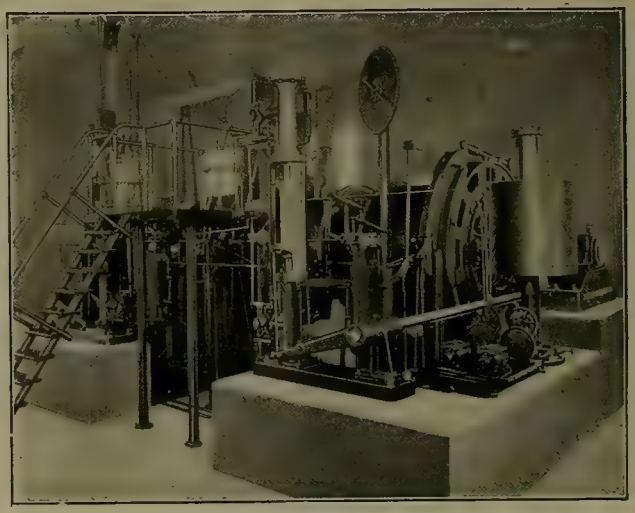
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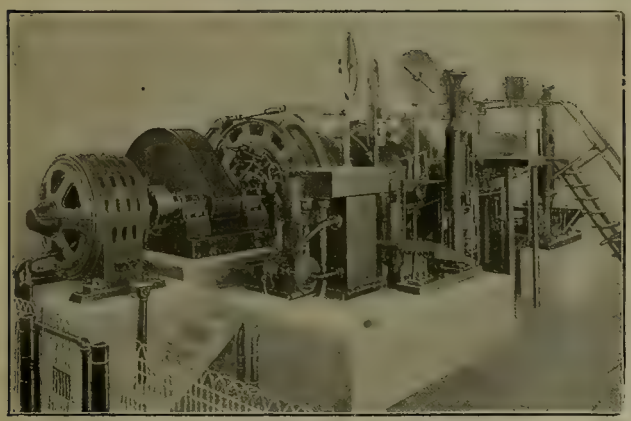
The Nordberg hydraulic control for electric hoists makes the hoist operation entirely independent of everything except the electric current itself. It complements the electric motor drive.

The control consists of oil-operated thrust cylinders, served by an accumulator and motor-driven oil pump, which is shown clearly in the right hand foreground in the accompanying photograph of a hoist recently installed by the Utah Apex Mining Company.

In the center of the picture is a double-acting thrust cylinder for operating the clutch, and to the right of this a single-acting thrust cylinder for relieving the brake against the pressure of the dead weight. All Nordberg brakes are of the parallel motion post type, applied by a dead weight, and the thrust cylinder which relieves them is fitted with Nordberg floating lever control, which gives greater delicacy of manipulation than could be obtained by hand operation.

This hoist is an excellent example in all respects of the latest practice in high efficiency electric hoist design. The drums are 7 ft. in diameter and 54-in. face, for 3000 ft. of 1⅛-in. rope. The unbalanced rope pull is about 20,000 lb. The drums are driven through cut herringbone gears fitted with an oil-tight gear guard, by a 500 H.P. continuous rating, 60 cycle, 3-phase motor, with liquid rheostat control. This equipment is clearly shown in the photograph reproduced below.

For further information on the numerous important features of design in Nordberg Hoists, send for Electric Hoist Bulletin No. 24, and if interested in Steam and Air Hoists, Bulletin No. 23.



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NORDBERG MACHINERY

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SPELTER production is responding to the lower price of the metal, the output in the first quarter of the current year being estimated by Mr. W. R. Ingalls, according to the 'Boston News Bureau,' at 136,000 tons, compared with 153,296 tons in the last quarter and 183,150 tons in the first quarter of last year.

OUR correspondent at Victoria gives a summary of the policy adopted by the government of British Columbia in regard to the taxation of mines during the period of the War. The tax is to be based on income or on 2% of the assessed value of the ore removed, whichever be the greater. Depreciation up to 15% is allowed. Gold-mining companies are to be taxed only on their profit, in recognition of the fact that the price of gold is fixed.

UPON another page we print the speech made by Capt. R. Hodder-Williams at the War Smoker of the Institute during its meeting at New York last February. We obtained the text of this speech from the current bulletin of the Institute. Capt. Hodder-Willams is a British officer in charge of training the students of Columbia University. We would like to have heard the speech; it is a pleasure to publish it, for we know that it will be appreciated..

THE selection of Ferdinand Foch to command the Allied armies and of Charles M. Schwab as commander-in-chief of our shipyards suggests how little indicative of national allegiance a name may be. The casualty lists of the British army, of the French, and of our own, of course, prove that a German name need not indicate either birth in, or allegiance to, the enemy country. It is said that Von Mackensen's name was corrupted from Mackenzie!

READERS of this paper will welcome the article by Mr. P. B. McDonald, whom they will recall as a former member of our editorial staff. Mr. McDonald is now on the faculty of the University of Colorado, helping a propaganda in which we are keenly interested, namely, the proper use of the official language of the United States, particularly when employed to convey ideas current in the technology of mining and metallurgy. His article on the expansion of a mining company's activities, or the productive continuance of a good organization, deals with a subject on which we have had something to say more than once. He gives point to his remarks by referring to individual examples of this policy and we shall be surprised if his article does not elicit some useful discussion.

HOW work in behalf of the Liberty Loan has caused business-men to drop their own affairs, in order to attend to a national duty, is shown by the marked decrease of mail-matter during the past week. Most of the outstanding men of business in all our principal communities have devoted the major part of their time to soliciting subscriptions, incidentally smoking out the slacker and the enemy-alien, of whom one is about as bad as the other.

TECHNICAL science in its peaceful aspect is bound to suffer from the War; that is one of the minor sacrifices to be made for a great cause. For example, the writer of the article on the Aroroy gold-mining district, Mr. E. H. Clausen, is now a captain in the Engineer Officers Reserve Corps in training at Camp Lee, Virginia. The response made by mining engineers and metallurgists to the call of their country has been splendid, as we know by the hundreds of men that have sent us either their change of address or the unavoidable cancellation of their subscription. We are proud to number so many good citizens among our supporters. On the other hand, their places have been taken by older men, above the draft age or otherwise unavailable for military service, and to these we give a friendly welcome, because they also are doing what they can to sustain the Nation in its purpose.

REPORTS of the Federal Reserve Bank, which are made monthly, show a total stock of gold amounting to 3050 millions of dollars at the end of March. Of this quantity the requirements for a reserve against outstanding paper is approximately 1150 millions, leaving 1900 millions of free gold, in the bankers' sense of that term. The ratio of gold reserves to net deposit and Federal Reserve liabilities combined is 60.8%, while the ratio of total reserves to these items is 62.9%, as compared with respective percentages of 82.7 and 84.8 a year ago. It is interesting to note that the curve of living-

costs reached its pinnacle at the same time as the high point in the total gold reserve. Living-costs receded slightly during May, June, and July 1917, but they composed the same index-number this month as obtained a year ago. Relative abundance of gold, therefore, does not wholly explain the cost of commodities, although its influence is indisputable. In connection with these barometers of the commercial world, the recovery of the market quotations on the leading industrial stocks is notable, these having risen from an average low mark of 63 last December to 79 in March. Railroad securities have not similarly responded, but the market price of these represents manipulation to a degree that does not obtain with regard to other stocks. Bank clearings, which may be taken as a measure of earning power through the movement of money, thereby indicating an off-set to the cost of living, show an increase this year, to the end of March, of 20.3% over those for the same period in 1917. This includes returns from 93.6% of the banking institutions of the country.

'HUNDRED per cent' is the slogan now among the organizations of business, meaning that every employee is expected to subscribe to the Liberty Loan. We are glad to say that our own staff has come up to the mark, but we find a more remarkable example set by the United Verde Copper Company, at Jerome, Arizona. Every one of its 2144 employees is a subscriber to the Loan. The company has assisted subscription by agreeing to advance the money required for the purchase of the bonds, permitting the men to pay for the same in five or ten monthly payments. The entire personnel of the company was organized into separate units, such as the mine, smelter, railway, tunnel, and improvement departments, with a consequent honorable rivalry to make a good record. In the mine each foreman worked for a record, the result being 100%. The distribution of nationality is interesting: American, 392; Canadian, 18; English, 18; Irish, 53; Scotch, 5; Welsh, 4; Mexican, 401; Spanish, 68; Portuguese, 5; French, 3; Italian, 57; Dutch, 1; Scandinavian, 21; Russian, 21; Finnish, 8; Serb, 32; Greek, 3; Slav, 96; German, 1; Austrian, 60; Bulgarian, 7; miscellaneous, 6. Considering the large proportion of aliens, the performance is unusually creditable. It sets an example that, we hope, will be imitated at every mine and smelter when the next loan is issued.

THAT high prices tend to retard consumption, thereby enabling us to send more commodities to our Allies, as stated by Mr. Richard Hoadley Tingley in an article published elsewhere in this issue; is an incontrovertible fact. The argument might be extended logically to the justification of profiteering, which has been a dominant influence in the elevation of market quotations on many necessaries. That evil emerged instantly at the outbreak of the War, and it was the prime reason for interference by the Government. High prices at that time certainly were not due to over-abundance of money, nor to the operation of the natural law of supply and demand. Only in minor degree did they reflect a warranted anticipation of an approaching shortage. The upward surge was a direct response to the opportunity for easy graft. Price-fixing may be conceded to be an evil also, but in that particular case it was the lesser of the two, and it is a valuable corrective when properly used. Except for authoritative restriction the market would have swirled to an insane height, causing infinite harm. It must be noted, furthermore, that high prices alone do not encourage economy. It is when prices rise without a corresponding increase in wages that consumption is reduced. The wage-earners represent the vast majority of the population, and their emolument has reached an unprecedentedly high level. Consequently the cost of commodities has been paralleled by an enormous increase in the purchasing power of the people. The chief danger from price-fixing, as we stated when it was first proposed, consists in undertaking to discriminate between commodities. Such is the inter-relation of industries that a market disturbance affecting a few articles is soon felt by all. If some remain free from control while others are fettered, the restricted industries inevitably must suffer. That is what has happened, and consequently the production of many needed supplies is curtailed. The principle of democracy and of sound business is to apply one rule to all. In times so abnormal as these no reliance may be placed upon the spontaneous operation of economic laws. The Government has been forced to protect the public against profiteering, but it should avoid the imposition of unequal burdens and restraints, while the supplies needed for the exigencies of war, both here and abroad, should be commandeered at the established rates.

OPINION at New York and Washington forecasts an increase in the fixed price of copper from the present figure of 23½ cents to the higher level of 25 cents per pound. Apparently the market is discounting this decision. The refiners of the metal claim that they are losing money on existing contracts and are compelled to raise the charge for treating blister copper. The big producers of copper assert that miners are being paid on a basis of 27 to 28 cents per pound for the metal, and that not only have wages advanced disproportionately but the prices of the materials used in producing copper have risen from $4 to $14 per hundred pounds since the War began, that pig-iron has risen from $14 to $33 per ton, and that the conditions of the market render logical the fixation of the price of copper at 25 cents. Few of the big companies, it is stated, are making a profit of 8 cents per pound; some of them are making no more than 6 to 7 cents per pound net. That does not sound convincing to the average citizen; for the matter of that, the arguments of special interests at this time are clouded by profiteering, which is the chief sin of business against the national and allied cause, the cause, as we believe, of civilization in its largest and highest sense. The purpose of any fixation of price is to restrain speculation in a necessary war-material and yet to stimulate production. Will 23½ cents suffice for the purpose? It is said that the smaller producers and those exploiting low-grade ore re-

quire a higher price in order that their operations may be fruitful. If that be so, it will be well to accord the necessary stimulant of a higher price while, at the same time, demanding an increasing national share of the big profits made by the more profitable mines. One fact must not be overlooked: while the production of copper in the United States is increasing, the supply coming hither from South America, notably from the Chile (Chuquicamata), Braden, and Cerro de Pasco mines, is decreasing, owing to lack of shipping. Taxes are heavy already, but they are inequitable, especially the excess-profit tax. What is needed is a regulation such as will stimulate necessary industry while at the same time preventing a few individuals from enriching themselves unduly at the expense of the Nation. It can be done.

The World's Gold Production

The statistics of gold production usually available early in the year are now to hand, so that it is possible to estimate the total output of gold in 1917. Such an estimate necessarily includes a guess as to about one-seventh of the total, although this fact is obscured in the elaborate figures published by various authorities. The United States and the British dominions furnish fairly accurate figures promptly, but other countries are slow in issuing statistics, sometimes postponing them for two years or more. However, the English-speaking countries produce 86% of the total output, so we are able to make a general estimate near enough for our purpose, which is to consider the status of the gold-mining industry. It will be noted that last year in every case the production declined. The principal contributor, the Transvaal, shows a decrease of $5,631,000, which, however, is relatively small, being less than 3%. In itself it is not significant, because the production last year was about equal to that of 1915 and a million dollars more than in 1913, the year preceding the War. That the gold-mining industry of the Rand is at its zenith of gross production and already past its zenith of profitableness is certain, but the decline may not be made manifest in statistics for several years, thanks to the expansion of the eastern end of the great goldfield. In the adjoining province of Rhodesia the decrease was about 10%. Toward the close of the year several discoveries of ore underground galvanized the market for Rhodesian shares, but there is no reason to anticipate any real accession of vigor to the gold-mining industry of a region that has been victimized by share-peddling and financial chicane. In West Africa —the Gold Coast—the decrease was also about 9%, the two chief producers, the Ashanti Goldfields and the Prestea, particularly the latter, showing signs of decadence. The Indian output of gold, which comes entirely from the Kolar goldfield, exhibits only a slight decrease, but the one lode that is being mined by four successful British companies is lean in the bottom workings and it is only the large quantity of ore in reserve that enables the mines to maintain a uniform output. A serious collapse is inevitable within a few years. The bulk of the Canadian production comes from Ontario, and predominantly from the Porcupine district, which in 1917 yielded $8,229,774, the average yield being $7 per ton. Of this total the Hollinger Consolidated Gold Mines contributed $4,233,777, or more than half. In the United States the yield shows a decline of about 8¾% as compared with 1916 and of over 16% as compared with 1915. California continues to be the foremost producer, yielding $20,815,900 in 1917, but in this State, as in every other except Arizona, there was a small decrease. Colorado's decrease was $3,240,000 and California's $1,160,000. Arizona advanced from $2,092,800 to $5,533,800, and the increase is significant because it was due to the production of gold as a by-product in the winning of copper. Whereas 66% of the gold produced in the United States in 1915 came from quartzose ores and 25% from placers, it is probable that in 1917 this proportion, making together over 90% of the total, decreased 6%, while on the other hand the yield from copper ores increased from 6% in 1914 to 10% in 1917. The report of the U. S. Geological Survey on this phase of the industry is not yet available for any year later than 1915, so these estimates are only reasonable guesses, but they serve to indicate an important trend in gold production, namely, that an increasing proportion of the output, in the United States in particular, and in other countries also, is being derived from the exploitation of base-metal ores, principally copper, but including lead and zinc ores as well. The Australasian output has been decreasing steadily for many years, owing to the exhaustion of the big mines in Western Australia and the decline of the older goldfields in Victoria, without an adequate corrective from fresh discoveries. Last year the total diminution in Australasia was a little more than 17%, which is a serious proportion. It is impossible to give an accurate estimate of the production of gold last year in Russia and Mexico, both these countries being in a state of anarchy rendering statistical inquiry out of the question. The guesses given in the accompanying table probably err on the hopeful side, for conditions in Russia became so much worse during the closing months of 1917 that systematic mining operations on a large scale ceased abruptly; the gold to be produced this year will have to come from small mines and from the depredations of unorganized mobs upon the workings of the richer properties, such as that of the Leskoie. It is evident therefore that the world's gold mining industry was hard hit last

	1917	1916	Decrease
United States ..	$84,456,600	$92,590,300	$8,133,700
Canada	15,449,426	19,234,976	3,785,550
Transvaal	185,871,016	191,501,929	5,630,913
Rhodesia	16,952,462	18,892,258	1,939,796
West Africa ...	7,420,388	8,134,234	713,846
Australasia ...	35,275,000	42,584,188	7,309,188
India	10,744,882	11,183,061	438,179
*Russia	20,000,000	31,000,000	11,000,000
*Mexico	10,000,000	12,500,000	2,500,000
*Other countries	28,000,000	36,000,000	8,000,000
Total	$414,169,774	$463,620,946	$49,451,172

*Estimated.

year, by the abnormal cost of labor and supplies, by political disorders, and by the continued depletion of the bigger mines. It is probable that the decrease of yield during the current year will be fully $50,000,000, the statistical data for the first quarter of the current year indicating a continued decline in the British dominions, while in Russia any systematic mining is impossible pending the restoration of some form of orderly government. In Mexico the outlook is better, but precarious. Everywhere the cost of labor and supplies continues to increase; the priority given to war orders hinders the equipment of new mines or the maintenance of machinery in good order at old mines. We are facing a world-wide decline in gold production.

The Pittman Silver Act

The enactment, by Congress, of legislation to regulate the purchase of silver has had an immediate result highly gratifying to the miner, for silver is established at the dollar mark. Secretary McAdoo, in his letter to Senator Pittman, recited the main facts: that more silver was required in order to settle foreign balances, instead of attempting to stabilize exchange by methods that involved future adjustment by means of gold, which is greatly needed at this time as a base for the huge structure of credit created by Government loans. Therefore 350,000,000 of the silver dollars stored in the Treasury will be converted into bullion. The stock of such dollars is 490,000,000, containing 375,000,000 ounces of fine silver, all represented by outstanding silver certificates. These are to be retired as the dollars are taken out of the Treasury and in their place Federal Reserve bank-notes of various denominations (including those of $1 and $2) will be issued. Of these notes only $11,670,000 worth is in circulation as yet. It is interesting to note that silver certificates have disappeared from circulation to a considerable extent, and it is open to question whether the necessary quantity of these certificates will be available as fast as needed for carrying out the purpose of the Act. Concurrently the Treasury is authorized to replace the silver thus used, for exchange and export, by the purchase of bullion on the market at $1 per fine ounce, coining this new metal into standard dollars. In this way the large accumulation of silver, occupying 40,000 cubic feet of space in the Treasury and weighing 12,880 tons, becomes available for war service. It is probable that the Government's purchases will absorb the entire output of silver from mines in the United States. The season of maximum export from Japan and China is now at hand and silver will be needed by American importers to pay their balances to the Orient; therefore the passage of the Act is timely. In March $9,946,351 in silver bars was shipped from San Francisco and in April $7,000,000. The advancing price of all commodities produced in the Orient has given the people of India and China an enormous increase of purchasing power, enabling them to convert their surpluses into silver as never before. That factor gains in importance from the circumstance that freight and insurance across the Pacific from this coast are considerably less than by the usual route from New York and London by way of the Mediterranean and the Suez Canal, where the submarine menace has raised the insurance against war-risks to a prohibitive figure. These abnormal conditions have called for special legislation. The Pittman Act is a war measure, not an experiment in bi-metallism; its object is to make use of the silver lying inert in the Treasury.

Further data will be timely. No silver dollars have been coined since 1904. About 20,000,000 ounces was purchased by the Mint last year to make half-dollars. The standard dollar contains 412½ grains of silver, its value being based on a gold equivalent of $1.2929 per ounce, so that with silver at $1 the seigniorage is 22.7 cents. The silver-value of subsidiary coins is 6.46% less, hence there would be a seigniorage, or profit on minting, even if silver stood at $1.30 per ounce. In other countries the seigniorage is even larger. The United States produced 74,244,500 out of the world's total production of 170,000,000 ounces last year. The increased demand for silver has been due to a variety of causes. An appreciation was inevitable when gold was withdrawn from circulation by the belligerent nations and silver became the principal metallic currency in daily use. In Mexico successive revolutions and persistent disorder caused a decrease in production from 87,000,000 ounces in 1911 to 30,000,000 in 1917. Meanwhile India enjoyed a series of good harvests and accumulated a big credit-balance with the warring countries of Europe. This called for silver. Exports to India raised the price of silver, but a crop failure would cause a commensurate drop, upsetting exchange. Hence the desire of the British government to stabilize silver, and thereby the rupee. The Indian demand for silver in 1916 was met by heavy exports from China, causing wild speculation, with restriction of trade. In September 1917 silver rose to 108 cents, a large export from San Francisco having developed. Thereupon the United States placed an embargo on export to China, except under license, and at the same time the British government restricted the shipment of silver to the Scandinavian countries. By that time the entry of the United States into the War, and the increased war expenditure of the British government in Asia, owing to the employment of Indian troops and the campaign in Mesopotamia, had intensified the scarcity of silver, previously induced by the subsidiary coinage required for the payment of European armies. The high price prompted the offering of old silverware, and the melting of coins, many of which became "more valuable dead than alive," but both of these sources of supply proved too small to check the intensified demand. The use of silver in the arts is increasing; in 1915 it was 29,891,271 ounces, an increase of 6,000,000 over 1908. This is due largely to the cinema business, which is expanding. Thus new conditions rendered imperative some co-operation between the American and British governments in order to stabilize silver and to ensure a sufficient supply for the exigencies arising from the War. That has been done.



War Excess-Profit Tax

The Editor:

Sir—There is one aspect of this tax upon which I have seen little comment in the mining journals, namely, the effect of the tax upon speculative enterprise. The risks must have commensurate rewards if speculative undertakings are to be continued, but, in general, this tax diminishes the rewards about half (the tax is 60% on all profits over 33%) on the more speculative enterprises. In other words it doubles the risk for the same reward.

An illustration of the effect of this tax in a hypothetical, but common, condition of affairs is interesting. In developing certain classes of mining prospects a reasonable assumption would be that the risk is such that an average of ten prospects have to be developed to make one mine. The one mine must then pay back the capital spent on all ten before any return can in reality be considered as profit. Continuing, let us say that a man, in connection with his other business, spends a period of ten years in developing prospects. He spends $90,000 in developing nine prospects that are of no value, but he still persists, and in the last year he spends $10,000 on a prospect, makes a mine of it, selling it to an operating company for $200,000. To the mining man the 100% profit as a reward of many years of endeavor, loss of interest, and risk assumed, would seem modest, in fact, not particularly attractive. As I understand the law, however, the Government assumes for purposes of taxation that he has made a profit of $190,000 on a capital of $10,000. His excess-profit tax plus his regular income-tax would then be considerably over $100,000 and instead of making something he would have been taxed out of any reward for his time, energy, and persistence over a period of years, together with the confiscation of a goodly part of his capital of $100,000.

I may be wrong in my interpretation of the law, but I can find no provision, in such a case as the above, allowing him to write off the losses incurred in the prospecting of previous years against the profit of the year in which the tax is levied. Even if the interpretation of the law allows him his actual capital investment of $100,000 the war excess-profit tax would be $47,000, his ordinary income-tax would be something over $5000, so he would have left a profit of about $48,000 for a ten years endeavor. He would have made as much as if he had invested in some stable bonds with practically no risk attached. Risky and speculative undertakings are not conducted for such rewards and in my own experience I note an increasing disinclination of capital to engage in such enterprises under the present handicap of drastic taxation. In fact, this tax has already stopped much of the developing of prospects into mines and will be more effective in this way when its meaning is more fully understood.

One does not complain of this tax where it is really what it sets out to be, a tax on excessive profit, and is levied on the extra profit created by war conditions, but development of mines, oilfields, and other opportunities for steady industries to follow was slow enough, from the point of view of the welfare of the country, without this extra burden; with it, I fear, a period of stagnation for many desirable industries is approaching rapidly if not already here. We need the development of our resources in practically all forms of mining both during and after the War. "The prospect of today is the mine of tomorrow."

Let us have some public consideration of this question by other engineers, and, if the law as it stands is to the detriment of our country's welfare, let us see if it can be amended so as to bear only where it purports to bear, and does not stifle industry. I suggest an open discussion of the question.

E. W. Stebbins.

San Francisco, April 22.

Iron and Steel Technology

The Editor:

Sir—In the March issue of 'The Mining Magazine' (London) there is an editorial calling attention to the fact that the American Institute of Mining Engineers in its transactions continues to make a specialty of iron and steel papers, although an American Iron & Steel Institute was formed some years ago. This criticism will, I am sure, meet with approbation from hundreds of members of the American Institute of Mining Engineers. Iron and steel technology forms a specialty which requires all of the time of an engineer to master and hence the iron and steel men can more naturally group themselves together in a special institute, thereby relieving the transactions of the American Institute of Mining Engineers of a raft of papers interesting only to the iron and steel men.

H. W. Turner.

San Francisco, April 8.

[This is a debatable subject. We have long questioned whether the separation between coal, iron, and steel, on the one hand, and the non-ferrous metals, on the other, would not have to be recognized. We shall be glad to see the subject discussed in these columns.—Editor.]

Simplified Price-Level Economics

By RICHARD HOADLEY TINGLEY

The old 'quantity-of-money' theory of prices will not down. Many still cling to the notion that the more money we have, be it gold, or silver, or uncovered paper, the higher price-levels will mount automatically. We have more money in the country than we ever had before. Our currency issues amount to $4,896,801,905. This is just about $48 per capita. It is almost exactly $10 more than it was a year ago. Here is the seat of the trouble; this reveals the reason why prices are constantly rising; that is what the 'quantity-of-money' theorists say. If this is not reason enough, they aver, look at the existing ratio between currency and gold. Of the $4,896,801,905 in paper money afloat, only $2,363,636,860 is represented by gold, or about 48%; the other 52% represents inflation.

The rise in price-levels can be accounted for easily enough if we forget all about the 'quantity-of-money' theory that is so constantly being held before our eyes. Some of the banking institutions that think it their duty to lead the uneducated mind into right lines of economic thinking are not inclined to let us forget the danger involved in an over-supply of gold, or an inflated currency, or apparently easy credits, but the over-supply of gold and the inflated currency have not yet produced a condition of easy credits, nor are they likely to do so. The only state of easy credits that has yet been discovered in our present abnormal financial condition is that the United States government seems to have all the credit it wants. Its people think so, at any rate, as evidenced by the unprecedented sums of money they are lending now. Here is the seat of the misconception. It is the United States that is being expanded through her easy credits, not her people in commercial life. The United States is being expanded (inflated, if you like) and her people are doing it for her, and doing it willingly, while their own private transactions in credits are on a most reasonable and normal basis.

Inflation in the credit of a nation engaged in financing the gigantic enterprise in which the United States is now occupied is an obvious necessity. Two blades of grass cannot be made to grow where formerly there was but one, without extraordinary exertion. This extraordinary exertion by our Government has made an inflation in credits imperative. A currency issue of a much larger amount will soon be just as necessary if the War lasts long enough. It may reach even $75 or $100 per capita. But it will reach neither figure unless it is demanded as a war necessity. We have not yet succeeded in making two blades of grass grow where formerly there was but one, but we are on the way, and the thing will be done. In the meantime, and until we have accomplished this feat, war has materially lessened our supply of 'goods and service.' A large portion of our goods and service, formerly consumed at home, is now being consumed by our European allies. When the supply of goods and service is lessened, prices rise. Gold and currency have nothing to do with it. As the home supply diminishes, the demand increases, and, naturally, higher prices follow. High price-levels have a tendency to retard consumption. It is necessary that our home consumption of commodities be retarded to enable us to send more commodities to Europe. Therefore, high prices are a necessity until we have learned how to make two blades of grass grow where formerly there was but one.

Price-fixing is an experiment that is being tried by our Government, in the hope of doing what? Of tending to bring about a condition that will make for lower price-levels? Surely it cannot be that the Government wants to bring about a lower level of prices now. A lowering of price-levels would automatically stimulate home consumption of goods and services so badly needed for export to Europe. It cannot be that the Government wants to do this.

All the finely drawn theories of political economy fall to the ground when tested under the conditions that now face us. Theories of 'quantity-of-money' and 'rapidity-of-circulation' may be well enough for the class-room. Their study is good mental gymnastics, but until we have finished that little job of making two blades of grass grow in the place of one, high and mounting prices are an economic necessity. The law of supply and demand, if left to do its work without hindrance, will see to it that prices do not come down. Home consumption will thus be retarded. Should the price-fixing policy of the Government produce a condition that will tend to keep prices from further rise, and, sympathetically, make for a reduction in price-levels in some instances; then will an invitation be automatically sent out that will stimulate home consumption. Then it may be necessary that we turn our attention to making three, instead of two, blades of grass grow where formerly there was but one.

LEAD SULPHIDE ore, containing silver or copper, may be treated as follows, according to a method recently patented by Robert de Luce. The ore is ground, and the lead sulphide decomposed by a hot solution of $FeCl_3$, leached with a 12% solution of $FeCl_2$ at a temperature of 90°, or with some other solution having a similar solvent action on $PbCl_2$. The copper and silver are electrolytically deposited, using iron or lead anodes. The solution is then electrolyzed in a diaphragm cell with steel cathodes and carbon anodes to deposit the lead and regenerate the solution for leaching fresh charges of ore.

Should Mining Companies Expand?

By P. B. McDONALD

To assert that the mining of a definite orebody is a process of exhausting assets is a truism. To avoid the ignominious ending of a skilled organization many mining companies acquire new properties. They argue with a good deal of truth that a going company, having its corps of technical workers and its necessary apparatus, stands at an advantage in the testing and development of prospects. It has often seemed a pity that, because of the exhaustion of an orebody, an organization of capable men should be disbanded and scattered. What is sometimes lacking is initiative or imagination; again the fear of making a mistake and spoiling a good record inhibits the moving spirits from taking chances. Sometimes they are right in deciding to close the chapter and read the obsequies, for it is better to do so than to blunder badly. A study of the methods of prominent mining companies during recent years reveals all shades of opinions and policies concerning expansion, from the decision of the short-lived but profitable Seneca-Superior Silver Mines, Ltd., to write 'finis' on its books, to the vigorous expansive ramifications of such operators as the Calumet & Arizona Mining Co. and Tonopah Mining Co. In contrast with such progressiveness is to be mentioned the peculiar lack of imagination sometimes shown by a dominating company in its own district, such as the indifference of the United Verde Copper Co. to the possibility of new orebodies during the years in which it was the sole operator at Jerome. When a large and prosperous mine is the principal attraction in an out-of-the-way district, its management is apt to assume a deprecating air regarding further prospecting in the neighborhood, implying that their company, in its never-failing wisdom, would know all about other orebodies if any existed.

It is interesting to review the short history of the Seneca-Superior Silver Mines. This company, in which the moving spirit was W. E. Segsworth of Toronto, had an eight-year lease on a high royalty upon a small tract adjoining the property of the Nipissing Mines Co. at Cobalt. For several years the developments, mostly under a lake, were discouraging. Then, in the four years from 1913 to 1916, over $2,000,000 was produced, of which $1,579,817 was distributed in dividends, or 326% on the capital of $500,000. The vein was then exhausted, and the prospect for finding others was discouraging; so the company decided to wind up its affairs. A different course, such as other Cobalt companies have chosen, would have been to look for new leases or options, for example, at Porcupine, but the company decided to let well enough alone. Several of these companies, as their ore-reserves dwindled, sought new mines elsewhere. After the wonderful richness of the Cobalt veins, some of their ventures seem disappointing. La Rose Consolidated Mines Co., after exhausting the ore of the La Rose, Princess, Lawson, University, and Fisher-Eplett claims at Cobalt, took options on a copper mine in New Brunswick, on the Hurd gold mine at Kirkland Lake, and on the Maidens-MacDonald gold mine at Porcupine. The results to date have not been encouraging. The La Rose company has paid in dividends an amount practically equal to its capital stock, namely, $7,500,000.

The Crown Reserve Mining Co., which has paid $6,190,-849 in dividends on a capitalization of $2,000,000, produced principally from its original holding of 23 acres under Kerr lake, has received several hundred thousand dollars in dividends from the Porcupine Crown Gold Mining Co., in which it owns 60% of the stock, but the latter appears to be a short-lived mine, with no very rosy future. The Crown Reserve also tried financing the Newray Mines Co. at Porcupine, a re-organization of the much advertised Rea Consolidated Gold Mines, but finally abandoned it. The Crown Reserve relinquished options on the property of the Globe Consolidated Mining Co. in Trinity county, California, and on gold claims at Boston Creek, Ontario, after the developments had proved disappointing. A 90% interest in the Reward mine, in Inyo county, California, was purchased; this is a small mine, equipped with a flotation plant, assured of a return of capital and a fair profit; however, the gross returns are likely to be only several hundred thousand dollars. Other Cobalt companies that are entering new fields include the Beaver Consolidated Mines, which, like its neighbor, the affiliated Temiskaming Mining Co., is selecting prospects at Kirkland Lake, Porcupine, and Cobalt; the Mining Corporation of Canada, a British organization, which has examined and turned down a great many widely-scattered North American prospects, but which is making a large production of silver from its several mines at Cobalt; the Dominion Reduction Co., operating the Nova Scotia silver mill, and owning the rich Croesus gold mine 50 miles east of Porcupine, as well as other interests; the Coniagas Mines, which has paid $8,440,000 in dividends on a capital of $4,000,000, and which controls the Redington Rock Drill Co. and Mines Water Supply Co., and has paid $20,000 for the Maidens-MacDonald gold mine at Porcupine, besides owning a silver smelter at Thorold, Ontario.

The prosperity of the companies at Cobalt has been one reason for their willingness to branch out, but perhaps the very richness of the Cobalt veins, as already suggested, has made their ventures elsewhere seem disappointing. Nipissing, with the biggest and best holdings at Cobalt, has been a conspicuous example of a pros-

perous company that is not interested in acquiring properties in other districts. The reason probably is that Nipissing has plenty of territory for prospecting within its own confines, for it has 846 acres containing over 100 veins. Undoubtedly when a favorite dividend-payer begins to take chances on other prospects the stock market takes a pessimistic view of the matter. Such has been the case with the Calumet & Arizona Mining Co. Its stock was more favorably regarded in the markets before it commenced to expand than after it began financing the New Cornelia Copper Co. and agreed to spend $100,000 in the exploration on the Gadsden Copper Co. at Jerome. Yet New Cornelia has been a distinct success, for the 76% of its stock owned by the C. & A. was acquired at $1.76 per share, as compared with a present market-value of about $16, and dividends from New Cornelia will soon add considerably to the parent company's income. The psychology of the matter is, probably, that buyers of shares like to figure on a self-contained mine where as many complicating factors as possible have been obviated. The Calumet & Arizona is a company with the best reason in the world for expansion; it is favorably situated in a mineral region of great richness with the peculiarities of which it is well acquainted; its staff possesses energy, good judgment, and adaptability; and its owners have initiative, imagination, and large resources.

The Tonopah Mining Co. of Nevada is an excellent example of a moderate-sized mining company that has expanded successfully. On a capital stock of only $1,000,000 this company, besides its 160 acres at Tonopah, owns 83¼% of the Tonopah Placers Co.; 55% of the Eden Mining Co.; 92% of the Tonopah Canadian Mines Co. of Manitoba; besides shares in other subsidiaries. The Tonopah Placers Co. operates three gold dredges near Breckenridge, Colorado, where the average yield, in 1916, was 12.7c. per yd., and the cost 7.2c., the revenue being $406,368, on which the net profit was $73,529, exclusive of depreciation on property and plant. The Eden Mining Co. has nine square miles in the Piz Piz mining district of Nicaragua, where a body of gold ore assaying $12 per ton has been found and partly developed. The Mandy Mining Co., a subsidiary of the Tonopah Canadian Mines Co., has a promising copper property near Schist lake, north of The Pas, Manitoba, on which 20% ore has been disclosed in a lens 200 ft. long. The Exploration department of the Tonopah Mining Co. existed for five years, from 1912 to 1917, and J. E. Spurr was in charge; the total cost was $261,108 and the total value of results is reckoned to be at least $8,000,000. This example is a good argument for a prosperous mining company that sees its reserves declining, to engage a capable geologist and acquire new properties.

The Guggenheim companies present a pronounced example of expansion. To analyze their complicated and interlocking interests would require the services of a certified accountant. For instance, the Kennecott Copper Corporation owns the Kennecott Mines Co., including the Bonanza and the Jumbo copper mines near Kennecott, Alaska, the 195-mile Copper River & Northwestern railroad from Cordova to the mines, the Beatson Copper Co.'s holdings on Latouche island, the Alaska Steamship Co. operating between the Tacoma smelter and the mines. 99% of the stock of the Braden Copper Mines Co., which owns mines in central Chile, 434,504 shares out of 1,624,490 issued of Utah Copper Co., which, in turn, owns slightly over 50% of the stock of the Nevada Consolidated Copper Co., and the Bingham & Garfield railroad with 111 miles of track; and many other properties. The affairs and assets of the American Smelting & Refining Co. are even more intricate and far-reaching. It mines, smelts, and refines gold, silver, copper, lead, and zinc, and manufactures them into sheets, rods, tubes, white lead, zinc white, sulphuric acid, and other things. It mines coal, and smelts tin, it owns ten railroads in Mexico, refines bismuth, cadmium, arsenic, nickel, platinum, palladium, selenium. The amount of metals produced by it in 1916 included: copper 394,719 tons; lead 279,144 tons; silver 71,868,451 oz.; gold 2,662,011 oz. The reason for combining such diverse interests would seem to be that the directors prefer to offset occasional disappointments by balancing them against successes; and then, too, the financial jugglery incident to these operations probably appeals to men so skilled in the game.

The Yukon Gold is another Guggenheim organization. Its holdings include 650 placer claims in the Klondike valley, 24 claims in the Iditarod district, Alaska, various placer areas in California on the American, Feather, Trinity, Yuba, and Butte rivers; a lease on property of the Coeur d'Alene Mining Co. near Murray, Idaho, and lode claims in the Jarbidge district of Nevada. These lode claims, under development by the subsidiary El Roro Mines Co., are estimated to have 214,000 tons of $15 gold ore blocked out. The Yukon Gold Co. has seven large dredges at Dawson, two at Iditarod, five in California, and one 7½-cu. ft. dredge in Idaho; yet the operations of this company have not realized expectations. From a high point of $8.50 in 1909 the stock has declined in the market to about one dollar per share. In its disappointment the Yukon Gold Co. can be compared with the Alaska Gold Mines Co. of the Hayden-Stone-Jackling interests, or with the Alaska Juneau Gold Mining Co. of San Francisco. Many stockholders of Alaska Gold Mines bought their shares at $40, which will bring now only about $2 per share, yet the Hayden-Stone-Jackling interests have not only picked a number of winners, of which the Utah Copper is the most notable, but they have not shown the disposition of the Guggenheims to combine good mines with poor ones in the same corporation.

It does not help an unsuccessful mine to combine it with another weak one, and it seems a pity 'to wish a lemon' upon a good property. Combinations do not always bring economies. On the other hand, it is a commendable policy for a company that finds its ore-reserves dwindling to acquire new property, particularly if its staff is capable. If the staff is incapable or the luck bad, things are apt to go wrong.

Possible Sources of Barium Carbonate

By SAMUEL H. DOLBEAR

It is important to stimulate prospecting for witherite, the natural carbonate of barium, and the new hypothesis here given may lead to further discoveries of this material. The only ore of barium produced in the United States until recently has been barite, which is the normal sulphate of barium. The residual deposits in Missouri have yielded by far the most important quantities, but it is not my purpose to discuss these or other residual deposits. A few years ago the Leona Chemical Co., of Elmhurst, California, undertook experiments in the manufacture of barium compounds, using barite from a deposit near El Portal, Mariposa county, California, as a source of barium. At the surface the ore was fairly pure barium sulphate. Further development of the mine showed a gradually increasing amount of barium carbonate, and on the lower levels, about 250 ft. vertically below the outcrop, witherite, in the form of a white ore of fine texture, was found, carrying in excess of 90% $BaCO_3$. The only associated minerals that I observed were pyrite interspersed through much of the ore in variable amounts, and some manganiferous material not intimately contained in the ore itself, but occurring in vugs or narrow veinlets. It is notable that the pyrite showed at the most only slight traces of oxidation. The barite-witherite vein cuts a belt of gneiss, which comes into contact with the late-Jurassic granites of the Yosemite a few hundred feet farther north.

The key to the hypothesis which I present lies in the fact that the upper part of the vein is rich in barium sulphate, and that it gradually gives place to carbonate as depth is attained. I appreciate that the advocates of the theory that barite was deposited from descending solutions may point out this fact in furtherance of their belief, accounting for the upper zone of sulphate by the fact that barium sulphate is less soluble than the carbonate, and would therefore be deposited first. Barium as sulphate is relatively insoluble in either magmatic or in aqueous solution. Its presence in nature as a silicate is rarely recorded, nor does it combine readily with other acid radicals, with the exception of carbonic acid, to form the minerals of commerce. It seems probable, therefore, that the primary ore in the El Portal deposit was barium carbonate. Oxidation of sulphide minerals, both in the ore itself and in the enclosing rocks, would result in the formation of sulphuric acid, which would readily convert the carbonate to sulphate. This would continue to whatever depth such acidic solutions might penetrate, or until the acid had been completely neutralized. If the volume of acid is sufficient to completely alter the carbonate, then, of course, no witherite would be present. The small amount of oxidized material in the El Portal deposits indicates that erosion has kept pace approximately with the oxidation.

At the Hatton manganese mine near Aguila, Arizona, barium carbonate is associated with the ore, and at one point it nearly replaces it as a vein-filling. As the manganese ore is residual, embedded in unconformable sandstones, the relation between the two minerals is not



HATTON MANGANESE MINE, AGUILA, ARIZONA

genetically important, the barium being of later deposition and probably related to nearby acid igneous intrusions through the sediments. The association of barium with manganese ores in many Arizona deposits, however, is characteristic, and justifies closer study.

At the Bardin mine near Hollister, San Benito county, California, the barium sulphate occurs as irregular lenses in limestone. Analyses of ten samples taken from the surface show traces of barium carbonate. This example, however, I regard as a type of a residual deposit.

It is not conceivable that it could have been altered from carbonate to sulphate, as at El Portal, without also forming a considerable body of associated gypsum. Hill* refers to occurrences of this type as replacement deposits.

Barite is nearly always associated with sulphides or their resultant oxides. It is not probable, therefore, that witherite may outcrop at the surface, owing to its ready affinity for acid solutions derived from the zone of oxidation. Barite deposits should, therefore, be prospected at depth for witherite. Deposits so prospected should, of course, be large enough so that if witherite is found, it would be likely to exist in generous amounts. Closeness to rail transportation is another important factor. Deep oxidized zones should be avoided. In regions of fairly rigorous climate, with resultant active erosion, the presence of sulphides or the absence of oxides in considerable amounts should be noted. The deposit to be tested must be in veins, and the existence of acid igneous intrusives close by may be found to be significant in some cases.

With these rather crude guiding factors at hand, it is necessary to prospect the vein in depth, which may be done by any of the usual methods, such as core-drilling, sinking prospect shafts, or driving adits if the topography permits.

USES. If barium carbonate could be found in sufficient quantities in Nature, it would replace the sulphate in the manufacture of barium chloride, nitrate, and other salts. Its direct uses as a carbonate are, however, rather limited. Barium nitrate is in great demand during the War as a constituent of 'green fire' used in signaling. With the exception of small amounts of barium carbonate produced intermittently at El Portal, our entire supply is imported. Refined barium carbonate has been quoted during the past year at about $80 per ton.

FUEL-BRIQUET PRODUCTION of the United States during 1917 was 406,856 net tons, valued at $2,233,888, an increase over 1916 of 111,701 tons, or 38% in quantity, and of $788,226, or 55% in value, again breaking the record of the previous year. According to C. E. Lesher, of the U. S. Geological Survey, the demand for fuel was so strong throughout the whole year that there was no lack of market to limit the production of the briquet manufacturers. Despite the increased cost of binders and of manufacturing, most of the plants operated to full capacity and reported a prosperous year.

FERTILIZERS of all kinds will henceforth be subjected to Government control through the operation of an executive order for licensing the importation, manufacture, storage, and distribution of sulphuric acid, sulphur, phosphate rock, acid phosphate, basic slag, sodium nitrate, ammonium sulphate, cyanimid, calcium nitrate, potash salts, cement dust, blast-furnace dust, wood ashes, and all other fertilizer ingredients. The chairman of the committee having charge of this matter is Charles W. Merrill.

*James M. Hill, U. S. Geological Survey, Min. Res. 1914. Pt. 2, p. 63.

Selective Flotation in Australia

The highest grade of zinc concentrate being produced at Broken Hill is being turned out by the Bradford sulphur di-oxide selective flotation process, according to recent advices from Australia. The 65th half-yearly report of the Broken Hill Proprietary, Ltd., for the six months ended November 30, 1917, discloses the fact that slightly over 50,000 lb. of slime was put through the Bradford mill during the period, producing some 5600 tons of concentrate assaying 61.6% lead, and 83.2 oz. silver, and 13,400 tons of zinc concentrate. Since the reflotation section of the mill was started the average grade of the zinc concentrate has been 49.54% zinc, 4.34% lead, and 14.47 oz. silver.

Several of the other large mining companies at Broken Hill have had the process in use for over a year, the Australian rights having been purchased in 1917 by a combination of four of the heaviest producers—Amalgamated Zinc, Zinc Corporation, Broken Hill South, and Sulphide Corporation. It is our understanding that the treatment of the Broken Hill Proprietary ore does not involve the use of oil, emulsification being accomplished by the use of nitre-cake. The selective agent is SO_2 gas in acidulated solution. Both galena and blende become thoroughly wetted by agitation with the SO_2 solution, and sink, the galena then coming to the surface while the blende is kept in the wetted condition by the incipient chemical action of the sulphurous acid, being more susceptible than the galena. Pyrite follows the galena, the separation between iron and zinc being quite as well defined as between the lead and zinc. The Broken Hill crude ore runs approximately 15% lead, 15% zinc, and 14 oz. silver.

Several American, Canadian, and Mexican lead, zinc, and copper ores have been sent across the Pacific for testing at the Broken Hill mill during recent months, and preliminary reports just returned from Australia indicate the applicability of the SO_2 treatment to certain refractory ores on this side. The Bradford selective flotation processes are patented in all the principal countries of the world, Mr. Bradford's representative in America being Guy Riddell, recently returned to New York from Australia, and in Washington as consulting metallurgist to the United States Tariff Commission.

LOUISIANA, as might be supposed from its geographical position, receiving, as it does, the delta sedimentation from a great continental drainage basin, possesses a remarkable variety of clays. Almost every sort required in the industrial and decorative arts is to be found in that State. The U. S. Geological Survey has recently issued bulletin 660-E, dealing with these resources.

SODIUM ACETATE is in active demand, with the market practically bare of available supplies. The by-product charcoal makers are unable to meet the present requirements for acetates of any kind. Acetate of soda, for dyers' use, is now selling at 16 to 18c. per pound.

Commercial Aspects of the Shale-Oil Industry

By J. H. G. WOLF

The possible development of the shale-oil industry in western America as a means of augmenting the crude-oil supply is attracting much attention. The timeliness of the subject is undeniable because of the ever-widening demand, both for purposes of war and of peace, and because of the apparent inability of the oilfields of the United States to fully meet the increased need of petroleum products. Preliminary estimates show that this country consumed (inclusive of its export trade) 390,000,000 bbl. of crude oil in 1917, but produced only 335,000,000 bbl. The deficiency of 55,000,000 bbl. was met by drawing 20,000,000 bbl. from stocks and by importing 35,000,000 bbl. from Mexico.

The second reason for the manifest interest in oil-shale lies in the accredited existence of enormous reserves of such shale areas in the Western States, having a higher average oil content than the shale treated for oil abroad. Having the two conditions necessary for the development of an industry satisfied, namely, the fixed demand for its products, and the abundance of the raw material with which to operate, we may look forward with confidence to early developments of importance. Competition with natural crude oil would be impossible if the oil were the only product from the shale; at least that is true at the present prices. A market must be developed also for the ammonium sulphate that can be produced as a by-product in the distillation of the shale.

During the recent hearings at Washington before the Public Lands Committee of the House, on the pending Mineral Lands Leasing Bills (S. 2812 and H. R. 3232), which measures are to open, on the leasing principle, the remaining oil, coal, and phosphate areas on the public lands of the United States, delegates appeared from Utah, Wyoming, and Colorado, urging the necessity for considering, at the same time, the shale-oil problem, as there is now no specific law for acquiring title to these particular lands. Rights to shale land are being initiated under the placer-mining laws. Having in mind the unhappy experiences of the oil-land operators with this inept and archaic law, it is natural that those fostering the new industry should fear a repetition of the experience of the oil men with that statute.

It is necessary, also, to sound an alarm of another character. Among those who appeared for the oil-shales at the aforesaid hearings was one public official, Russell D. George, the State geologist of Colorado, whose testimony seems worthy of more than passing notice. Mr. George gave, on February 26, the benefit of 10 years' study and observation of the shale-oil industry and its possible development in the Western States. With true scientific and economic interest in the subject he fearlessly asserted that, regardless of promoters' claims, the only possible hope for commercial success lay in conducting operations on deposits yielding not less than 50 gallons of oil per ton of shale, and that these must be upon the very largest scale, with capital in ample volume, and with technical skill of the highest order. The crux of his testimony was that no operations of less than 1000 tons capacity per day, conducted under the best physical conditions, could hope to succeed at present, and that such operations would require an initial capital expenditure amounting to upward of $2500 per ton per day capacity, or $2,500,000 for a completed and running plant. That figure did not include a sulphuric-acid manufacturing plant for the refinery, which might add $300,000 to the sum, but it did presumably include the cost of opening a deposit of shale for mining operations upon the scale stated. The figures of Mr. George were corroborated by Arthur L. Pearse, an oil-shale technologist, who followed, and who spoke from 40 years experience abroad. The importance of such testimony may be realized when it is considered that oil-shale enterprises are being proposed, and some are reported actually under construction, planned for such limited capacities as 100 tons per day, and with a capital equipment of only $75,000 to $100,000 each. These, as pilot plants, will serve a beneficial purpose. Unless Mr. George views the situation and the requirements from too conservative a standpoint, there surely will be some financial and industrial wrecks on the highways of Colorado. Evidence was offered at the hearings, by a committee of the Utah section of the American Mining Congress, proposing cost estimates of $750 to $1000 per ton per day capacity as a basis for capital requirements, but unfortunately no minimum-quantity capacity-figures were included in the estimates. As substantiating the higher figures of Mr. George, the history of the Scotch shale operations offers an illuminating commentary. The works in Scotland reduce about 3,500,000 tons of shale annually, this being the output of six major plants. The industry was already established there when Drake drilled his first oil-well in Pennsylvania in 1859. In the 'seventies, as many as 50 different companies conducted the operations, which treated but 1,000,000 tons of shale annually, or about 60 tons each per diem. Today these 50 plants have been reduced (or consolidated) to a half dozen, while the output has been more than trebled, each plant treating 2000 tons per day. The margin of profit, even on that scale, is admittedly small. The Scotch shale is leaner than that of western America, but the operators abroad have the advantage of cheaper labor, and a larger by-product resources, that is, more ammonium sulphate, in addition to an exclusive oil market, because Great Britain has no natural oil deposits now known; and the market, moreover, is in the midst of a densely populated country. It is plain, therefore, that the capital expendi-

ture for a shale-oil plant must be on a scale not unlike that on which the 'porphyry' coppers of the West are conducted; the history of the Scottish industry, if correctly interpreted, confirms this fact unmistakably.

A further analysis, even superficially made and considered, of the elements that control oil operations on any basis gives warning to all who would venture hastily and insufficiently equipped within its province. It is a relatively easy thing merely to produce crude oil, a venture requiring only the wise selection of the right ground and enough capital to sink wells, because the bigger factor, the marketer and the refiner, will install the necessary pipe-lines and pump away the product. The producer's responsibility ends when he has got the oil on the surface. One hundred thousand dollars judiciously spent can frequently launch an oil venture in an average field. It is quite another thing, however, to be properly established in the oil business, which comprehends not only the simple matter of producing the crude staple, but the all-embracing enterprise of piping, refining, and marketing the finished products, wherein lie the bigger profits. Those who market as well as produce oil in California are capitalized as high as $15,000,000 to $100,000,000 each. While there are 300 oil-producers there are fewer than a half-dozen marketers. From the evidence obtainable it is apparent that to engage successfully in the shale-oil business the enterprise must consist not only in mining the raw material, but also in treating it by distillation, with a plant equipped to produce the oil and the ammonium sulphate, after which the crude oil must be refined and fractionated for its marketable products. Even then, without some marketing and distributing organization, including the many capital demands that it entails, an enterprise can fall just short of being a commercial success. Thus it appears that, to become properly established in the shale-oil business, the enterprise must have very nearly the same equipment as a natural-petroleum marketer, rather than that of a mere oil producer. Upon that premise the estimate that it will take $2,500,000 adequately to launch a single unit in the business is not unreasonable.

Other observations in the testimony of Mr. George are worthy of careful consideration by those interested. The main points are as follows:

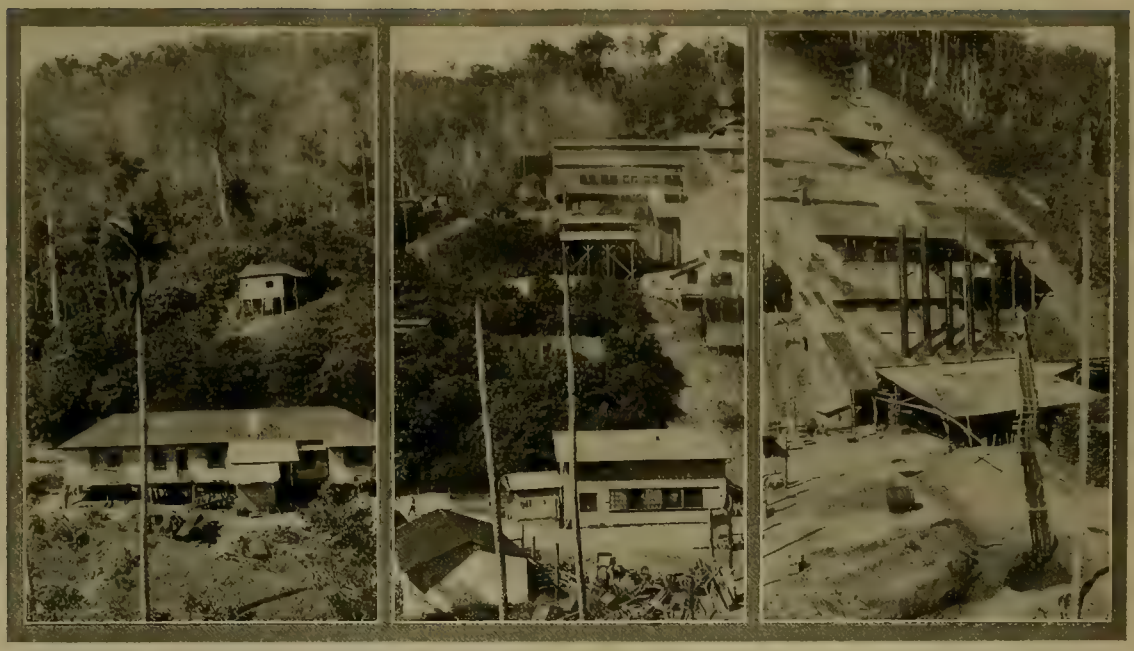
1. It requires a ton of water, in the manifold operations, to completely treat a ton of shale, and the shale deposits of western Colorado, southern Wyoming, and eastern Utah, embracing about 16,000 square miles of supposedly workable deposits, lie mainly at an elevation of 8000 ft. above the sea, where water is relatively scarce, and in a region famed for its aridity. The water-rights to the principal streams have, in a general way, long since been pre-empted. Engineering problems as well as technical problems of great magnitude doubtless face each new enterprise.

2. An oil-shale is not a mere container of residual oil; the shale is the depository of the remains of plant and animal life which, when distilled, yield hydro-carbons that associate in a form that make crude petroleum. Crude oil, as such, therefore does not exist in the raw shale; it is produced upon the application of heat to the shale.

3. The shale deposits can be mined exactly as coal, where the overburden does not permit of stripping and working with the steam-shovel. Coal is produced in Colorado at a total working cost of $1.18 per ton at the pit-mouth, and shale mining, though dealing with a tougher substance, should cost no more. The capital investment to open an ordinary coal mine amounts to 77c. per ton per year capacity; that of an oil-shale enterprise $7.50 per ton per year, and no operations should be undertaken on less than 6000 to 7000 acres, or, say, 10 square miles of deposits. This means that it will require 40 association placer claims of 160 acres each to satisfy the requirements as to acreage for one complete enterprise.

4. There should be obtained, on an average, from the richer shale worked at the outset (that is, the 50-gallon per ton shale) an extraction of 85% of the oil, namely, of the oil-making or kerogen content, and 60% of the 41 lb. of ammonium sulphate theoretically available. Many new processes of extraction have been proposed, which are being tried in the laboratory and on a small-sized working-scale, but the obvious procedure in designing the reduction plant is to follow closely the technology as developed in Scotland and France; not that no room exists for improvement in the foreign practice, but that no new principles have been developed among the foreign operators in a generation. The improvements made have related to the modes of practice. The Scottish plants consume from 80 to 200 lb. of coal per ton of shale treated, while in America the combustible gases, which issue on retorting the shale, should, it is stated, supply the needed fuel. Owing to the greater thickness of our deposits, an acre of western American shale land is alleged to contain ten times the amount of extractable oil yielded by an acre of Scottish shale.

Upon the conclusion of Mr. George's testimony, Mr. Pearse added, in substance, that the shale-oil industry is a more highly developed and a livlier one in France than in Scotland; that Spain and Brazil are getting busy with the industry, as are also Australia and other countries. He asserted that, if it had not been for the developed industry in France, the Allies would have been seriously handicapped for toluol and other compounds needed for making high explosives; that the grade of oil obtained in reducing the shale was determined entirely by the manipulation, as the main trouble in retorting lay in the carbonization of the material, which prevents the heat from penetrating the charge; that there are practically no commercial by-products save the available ammonium sulphate, and that the ash, after being drawn from the retort, consists of absolutely nothing but plain clay and sand, and offers but little chance of recovering potash commercially as had been alleged by some. Finally he said that the capital required for operation on an adequate scale is enormous, and that the facilities and the technical skill must be provided on a commensurate scale.



MILL OF THE COLORADO MINING COMPANY, PHILIPPINE ISLANDS

The Aroroy Gold-Mining District

By E. H. CLAUSEN

The Aroroy gold-mining district, in the Philippine Islands, first came into prominence in 1911 when the Colorado Mining Co. erected a 20-stamp, all-sliming, cyanide mill, and soon after declared dividends from successful operation. In that year H. G. Ferguson wrote 'The Geology and Mineral Resources of the Aroroy District, Masbate,' for the Division of Mines of the Bureau of Science at Manila. It is the most complete geological report of the district yet written. Since then, several minor reports have been made by the Division of Mines, and C. M. Eye has also included this district in his article, 'Gold Mining in the Philippines,' which appeared in the Mining and Scientific Press, June 17, 1916. The Island of Masbate is in the middle of the Philippine archipelago. It is the eleventh largest island in the Philippine group, having an area of approximately 1200 square miles. It owes its unique two-pronged shape to the junction of the prevailing anticlinal trends of the Visayan islands and central Luzon. The eastern arm parallels the mountain ranges of central Luzon, Samar, Leyte, and eastern Mindanoa. The western arm, which shows a change of direction of almost 90° from the eastern arm, parallels the mountain ranges of Cebú, Negros, Panay, Palawan, and western Mindanao. On the north-eastern end of the island, and north of the junction of these mountain ranges, is situated the Aroroy gold mining district, which has an area of about 75 square miles. All work so far has been confined to a mineralized belt about two miles wide, and running in a north-westerly direction. This belt has been prospected, and located in part, from the seashore at Aroroy, inland for 10 miles.

Old workings have been found on the property of the Colorado Mining Co. These, according to the inhabitants, represent operations during the Spanish occupation. The fineness of the gold and the lack of high-grade ore, however, gave little encouragement for extensive work by crude methods. During and after the Spanish-American war, attention was attracted to the numerous quartz outcrops. W. Edelmaier, who entered the district in 1898, is, perhaps, the first American to do any prospecting here. Later, Andres Herbert and H. B. Berkencotter discovered and opened the Colorado and Syndicate properties respectively, which are now the two largest gold producers in the Philippine Islands. Two gold dredges tried to operate in the district, but without success. Mining on an economical scale started when the Colorado Mining Co. built its 20-stamp cyanide mill under the direction of C. M. Eye in 1911. Previous to this, the Great Eastern Mining Co., now the Syndicate Mining Co., the Gold Bug property, and the Cogon Mining Co., all had erected

plants of 10 stamps, but they failed to make money, principally because amalgamation gave poor recovery of the fine gold, further interfered with by an excessive amount of clay in the ore. Since 1911 the district has developed rapidly, but not nearly as fast as it should, considering its situation and the difficulty of prospecting. It is at present the largest gold producer in the Philippine Islands. In 1913, the Syndicate, one mile south of the Colorado property, erected a 100-ton cyanide mill under the direction of H. C. Wilmot, formerly manager for the Colorado Mining Co. During the same year the Keystone Mining Co. constructed a 50-ton plant near Aroroy, and about two miles north of the Colorado mine, under the superintendence of A. C. Cavander. Since 1910 Mr. Schwab has been running a 5-stamp mill on small veins south of the Syndicate. In 1916 J. O. Enberg erected a 10-stamp amalgamation mill five miles south of the Syndicate, and is now developing a good prospect. In 1917 and 1918 O. L. Kettenbach erected a 5-stamp mill, of the Joshua Hendy individual-mortar type, one mile south of the Enberg property.

The island of Masbate is mountainous, and a large part is still unexplored. The Aroroy district mostly is heavily forested, and has a dense undergrowth. The ground that is not forested is covered with a heavy growth of cogon grass, the height of which varies from five to ten feet. A noticeable feature is that most of the mineral deposits are found in the forested area. Those deposits so far discovered in the cogon area are low in grade. The Lanang and Guinobatan rivers are the largest in the northern part of the island. They flow in a northerly direction from the central mountains and empty into Port Barrera. Except for a small area that drains into the sea along the east coast, the entire Aroroy district is confined to the watersheds of these two rivers. The Lanang river, which is navigable at high tide for a distance of three miles, is much used as a water-way for interior freight and supplies.

Ferguson states that the two cordilleras that form the southern boundary of the Aroroy district are in part composed of older sediments, largely slates, intruded throughout by large areas of diorites and more basic plutonic rocks, and associated with extensive later volcanic rocks of a rather basic type, ranging from occasional dacite, through andesite, to basalt and leucitite, with accompanying pyroclastics. These mountain ranges he has classed as pre-Tertiary, and the sedimentaries as of Miocene age. In the Aroroy district few sedimentary rocks are found. In the Guinobatan canyon, on the Limestone claim of the Syndicate Mining Co., a small body of bluish crystalline limestone, named the Mountain Maid formation, occurs. Along the seashore bordering Port Barrera and just north of the town of Aroroy coral limestone containing many fossils is found. The rocks of the district, however, are almost entirely igneous, consisting chiefly of diorites, andesites, and andesite porphyries. These have been divided into the Aroroy quartz-diorite formation and the Panique volcanic series. Although mapped as the Aroroy quartz diorite, this formation contains diorite, gabbro, and syenite. All deposits of value so far have been discovered in the diorite. Where the andesite and andesite porphyries occur, the ore deposits decrease in value and disappear. The diorite is of a bluish-green color, generally rather fine grained, with a granitic texture. It occurs as laccoliths throughout the central part of the area. On the east is a belt of granitic rock, called the Bolena granites or grano-diorites. A similar formation occurs on the western side of the district, on one large mountain west of the Lanang river.

The ore deposits, which are gold-quartz veins, are similar throughout the district, and are found always near or at the summit of the hills. This feature is so noticeable that prospecting is generally done on the apex of the outcrops. Commencing at the seashore at Aroroy, the various mining companies, named in order, each control a hill. The general strike of these hills is northwesterly. They are, Mt. Aroroy, Keystone Mining Co.; Mt. Bagadilla, Colorado Mining Co.; Mt. Kalakbao, Syndicate Mining Co.; Boston Hill, Schwab Mining Co.; Mt. Loia, Collett Mining Co.; Napwaunan Hill, J. O. Enberg; Belete Hill, Belete Mining Co. The veins in the northern part of the district, including the properties of the Syndicate, Colorado, and Keystone, strike N. 30° W., with a dip of 65 to 90° north-east. From Mt. Loia south, the veins strike from N. 70° W. to almost due east. The ore deposits are as a rule in a brecciated zone, composed of several quartz veins, with fillings of clay, or manganese, or both. The Colorado, which is typical, is mining from five different lodes and is developing two more. There are 15 parallel lodes from 100 to 600 ft. apart. The outcrop of lode No. 5, which has been worked for 1500 ft. continuously on the surface, can be traced about three miles. It is here and there as much as 100 ft. wide, the largest stope being 36 ft. wide. In places it has a beautiful banded structure, containing yellow and red clay seams, many quartz stringers, several bands of manganese oxide and quartz veins, together with a series of shear zones filled with brecciated quartz and manganese, or quartz and red or yellow clay.

The gold, which is not visible on megascopic examination, occurs in three distinct types: (1) a hard, white to cream colored, and sometimes bluish quartz, (2) a soft, spongy, friable quartz, (3) manganese oxide and quartz breccia, or a clay and quartz breccia. One of the lodes of the Keystone Mining Co. looks like the veins of the North Star mine in California, but has not given indication so far of persistence in depth. The Enberg and Belete properties have a hard bluish quartz vein impregnated with pyrite that has assayed as high as $25 per ton, in addition to the lodes caused by shearing and subsequent vein-filling. Calcite is also found as a gangue mineral. Deposition from silicious circulating waters is common throughout the larger lodes. Many of the smaller quartz veins are in fissures and do not show the silicious deposition characteristic of the shear zones. Chalcopyrite and galena have been found in the country rock. The depth of the ore deposits has not yet been determined. All mining as yet is by means of adits. The Colorado mine,

which is now 800 ft. below the outcrop on the summit of Mt. Bagadilla, has the deepest workings in the district and is still in the oxidized zone. Whether the ore will be persistent in depth is doubtful. Almost all the lodes are rich at the surface and rapidly decrease in value and volume downward. This depth in the smaller veins is about 75% of the length of the outcrop. In the upper workings the ore of the manganese stopes averaged about $14 per ton, while the same character of ore in the lower workings assays only $3 per ton. However, the harder quartz in the lower levels in places has changed but slightly in assay value below the upper workings.

Prospecting is difficult, on account of the rainfall, excessive vegetation, and the oxidized nature of the ground. Bolo men are necessary to cut the trails through the tropical growth. In some places the field of vision is about 25 ft.; in others the undergrowth, while not so dense, is covered with creepers and palms and other vegetation that greatly impedes cross-country travel. Trench work is of little importance owing to the depth of the oxidation. The cheapest and most satisfactory prospecting is by means of adits at such a depth as to insure seeing the decomposed formation. The cost of such work varies from 25c. to $1 per foot by contract, the company furnishing tools and powder. The Philippine mining laws are different from those of the United States. Any citizen of the Philippine Islands, or of the United States, is allowed to locate a mineral claim 300 metres square, but he cannot locate more than one claim on the same vein or lode. The side lines are vertical; there are no extralateral rights. Regulations for assessment work and patenting resemble the laws of the United States.

The average assay value of the ore now being mined is $8 per ton at the Colorado mine, $11 at the Syndicate mine, and about $20 at the Belete and Napwaunan properties. The largest operating mines are those of the Colorado Mining Co., with a capacity of 150 to 175 tons per day, and the Syndicate Mining Co. with a capacity of 100 to 150 tons. The Keystone Mining Co. is closed for lack of ore-reserves, due to insufficient development. The Belete and Napwaunan properties can be considered at present only as good prospects. Both the Colorado and Syndicate mines are efficiently managed by men of broad experience. J. S. Colbath, formerly manager for the El Rayo Mining Co. in Mexico, is manager of the Colorado, and J. J. Shaw, formerly with the Mountain Copper Co. in California and the United Verde in Arizone, is manager of the Syndicate mine. Stoping methods differ in these two properties. The Colorado uses principally a modified stull system, with posts and filling, while the Syndicate uses square sets and filling. The deposits are similar. The Syndicate is troubled with many transverse faults, which displace the lode from 10 to 25 ft. The Colorado has only one fault with a 25-ft. throw. The faulting, however, does not determine the method of stoping and timbering. In the Colorado, caps are used up to 25 ft. in length, with posts about 7 ft. or less apart, depending upon the ground. Sets are placed 5 ft. apart. Floors are 7 ft. high. The cap is placed in a hitch in the foot-wall, or on a post, and carried to the hanging wall as one piece. If the ground does not allow this, butt-caps are used as the work progresses. The average diameter of the caps and posts is 10 in.; round timber is used throughout. For lagging, round poles 4 in. diam., and either 6 or 12 ft. long, are



AROROY IS ON MASBATE ISLAND

used. The ground is often heavy, and the walls bad. All work is done by picking. The stopes are carried up by overhand work on successive floors. Filling is kept within one or two sets from the back. This is run down from the surface, or from the upper old workings. The problem is generally to keep the ground from caving, for country rock is calcareous and impregnated with oxidized iron pyrite. On exposure this ground slacks and crumbles, leaving the walls insecure. Stulling, untimbered stoping, and top slicing with casing, are also used in the district, depending on the nature of the deposits. Powder is seldom used except to loosen some hard ground.

Contract work is found to be the most satisfactory. Payment is generally made by the car, delivered to the ore-bin, or by the foot of advance, per foot of stope width on one floor, one set deep; that is, 7 ft. high and 5 ft. deep and 1 ft. wide, or else a fixed price per square foot. This may include delivery of the ore to the outside ore-

bins or to the chutes. While this cost is variable, the average price might be given as 25c. per 1000-lb. car, mined and trammed, or 45c. per foot of stope-width 5 ft. deep and 7 ft. high. All development is done by contract at a cost of 25c. to $1.50 per foot for a 4 by 6½-ft. drift. Matteson half-ton cars are used. Larger cars cannot be handled by the Filipino labor.

Labor

Efficient labor in the Philippine Islands is a serious problem. Laborers must be recruited from the soil, as the Filipino has done little or no mining. Furthermore, he has not the physique or stamina to do hard work. The average height of the Filipino is about 5 ft. 4 in. and his weight is about 130 lb. Each stope crew has a 'capataz,' or straw-boss, who oversees from three to ten men. Over these crews is generally another 'capataz' who has charge of one working level or more. Supervising this force is an American shift-boss. On account of popular superstitions it is difficult to obtain reliable night-shifts. Consequently, night-work is confined mostly to tramming and development work on contract. Stoping is done on the day-shift of nine hours. Common labor, trammers, shovelers, and miners are paid 50c. per day. Capataces, and a few of the better workmen, are paid 60 to 75c. per day. Japanese are used as carpenters and timbermen, and are paid $1.50 to $1.75 per day. A Japanese shift-boss is employed at one mine and a Japanese engineer at another. White shift-bosses and mill-men are paid $180 per month. Other white skilled labor is paid $125 or more. Food costs the Filipino about $5 per month and the white help $30 to $35 per month.

Owing to the scarcity of good manglar wood for fuel, internal-combustion engines are replacing steam. The Syndicate Mining Co. has two 150-hp. English Mirrles engines, and is about to install a Busch-Schultzer unit. The Colorado Mining Co. has installed a 500-hp. McIntosh & Seymour Diesel engine. These have given good results. Fuel-oil is shipped from Burma or Borneo by the Asiatic Petroleum Co. by steamer direct to the mine landings. All oil has been shipped in drums, but owing to the lack of bottoms, future shipments are expected to be in bulk and pumped from the steamers to supply tanks on shore. Oil costs $25 per ton.

The smaller mills of the district use stamps and amalgamation. The Syndicate mill is a 140-ton all sliming cyanide plant. The ore is supplied from the mine by a 1000-ft. gravity tram. A 3 by 15-ft. washer, formerly used as a dredge trommel, thoroughly washes the ore in solution, the fine passing to the Dorr classifiers direct, and the oversize from the ¼-in. screen is discharged into the mill-bin over a 1½-in. grizzly, by means of a 14-in. belt-conveyor. The grizzly oversize is crushed through a 10 by 16-in. Blake crusher and Sturtevant roller-jaw crusher and elevated to the mill-bin by a bucket elevator. From the mill-bin the ore is fed by gravity to a 6 ft. by 16-in. Hardinge conical ball-mill. The ball load is varied from 7000 to 9000 lb., depending upon crushing conditions. Frenier spiral sand-pumps elevate the ball-mill pulp to two Dorr classifiers, the slime flowing directly to 30 by 12-ft. and 30 by 9-ft. Dorr thickeners placed in parallel. The classifier oversize is fed to a 6 by 16-ft. Abbé pebble-mill, which returns its product to the Frenier pumps, thus completing the cycle. Hard quartz from the mine is used as mill feed for the pebble-mill, on account of its cheaper cost and the difficulty in obtaining flint pebbles. The thickener-pulp is raised by diaphragm pumps to an agitator consisting of a 30-ft. tank in which a number of 6-in. pieces of pipe, each acting as an individual air-lift, are hanging from a revolving mechanism, similar to that of a Dorr thickener. This type of agitator was described in the Mining and Scientific Press of July 19, 1913. The agitated pulp is filtered by Kelly filter-presses, and the pulp is discharged into the Guinobatan river. After passing a sand clarifier, the thickener-overflow gold-solution is precipitated in five wooden zinc-boxes. The bullion is shipped to the United States Mint at San Francisco, California. The recovery is about 93%. The 20-stamp all-sliming cyanide mill of the Colorado Mining Co. was the pioneer mill of the district. This consisted of a 10 by 20-in. Blake crusher, twenty 1250-lb. Traylor stamps, two Dorr duplex classifiers, three 5 by 18-ft. Traylor tube-mills, five 15 by 28-ft. Dorr thickeners, and a locally made Moore filter. The mill when erected included two 12 by 40-ft. Pachuca agitators, and two 11-ft. Oliver vacuum filters. These were discontinued soon after the erection of the mill. In order to treat economically the large amount of low-grade ore in the mine, the original mill was entirely re-built during the latter part of 1917, at a cost of $50,000, under the management of J. S. Colbath, and I served as superintendent of construction.

The present mill is a compact plant, consisting of a 10 by 20-in. Blake crusher, which discharges into a 1000-ton mill-storage bin. From the mill-bin the ore is fed to a 50-ton automatic feeder, which furnishes a steady feed to a 5 by 6-ft. cylindrical ball-mill. The ball-mill product is raised by a bucket elevator to a Caldecott cone. The overflow from this cone goes to a Dorr duplex classifier, and the discharge to a 5 by 18-ft. Traylor tube-mill, whose product is returned to the Caldecott cone. The oversize from the classifier is fed to a second 5 by 18-ft. tube-mill, which returns its product to the cone. The overflow from the classifier is run to three Dorr thickeners, one acting as a primary thickener, and two as secondary thickeners. The thickener underflow goes to two 12 by 30-ft. Pachuca agitators, and then to a Butters filter. The gold solution from the thickeners is clarified in a canvas vacuum-filter. The gold is precipitated in five wooden zinc-boxes. The bullion is shipped to the Selby Smelting & Lead Co. at San Francisco.

The Aroroy district still presents opportunities for prospecting and investment, but the present development of the district does not offer chances for mining on a large scale. Mining in the Philippine Islands, however, is still in its infancy.

Classification of Furnace-Slags

By HERBERT LANG

For purposes of study and comparison, to reach results of higher utility, various classifications of slags have been made, based for the most part on internal characters, or upon peculiarities of production. They are classified in the first place in accordance with the predominant acid constituent, whence we have silicate slags, phosphate slags, aluminate slags, titanate slags, and fluoride slags, which are characterized by the chemical compounds bearing the respective names. Sometimes slags are labeled 'acid' or 'basic', the reference being to chemical composition, the first term signifying a predominance of the acid member, and the second that of the base. They are classified also in accordance with the special metallurgic process in which they are produced, such as 'iron' slags, 'copper' slags, and 'lead' slags. Ordinary furnace slags are essentially mixtures of silicates of various bases and of different degrees of acidity, in which they are dissolved as accidental and usually unrelated substances. When these accidental substances begin to predominate in a given slag it receives the name of the new chief component, the silicates taking subordinate rank. In some instances all the acid radicals mentioned above occur in a single slag, and only in a few is but one of them present. Of the slag-making constituents in ores silica is the most widely disseminated, therefore it is advisable to begin the systematic study of the subject with compounds of that acid, giving consideration to the remaining substances as in effect replacing the original silica, appearing as phosphates, titanates, and so on.

Metallurgists have adopted a classification of silicates, both natural and artificial, based on the relative proportions of basic and acid oxygen contained in the compound. In the molecule of a mineral, such, for example, as wollastonite, the native silicate of lime, the basic oxygen, being that contained in the lime, amounts to one atom; the acid oxygen, being that contained in the silica, amounts to two atoms; hence the substance is termed a bi-silicate. Fayalite, the native silicate of iron, which has two atoms of basic to two of acid oxygen, is termed a singulo-silicate. The chemist, looking only at the molecular constitution of things, considers both as mono- or proto-silicates. In the metallurgical classification, sub-silicates contain two of basic to one of acid oxygen; singulo-silicates, one of basic to one of acid oxygen; bi-silicates, one of basic to two of acid oxygen; tri-silicates, one of basic to three of acid oxygen; quadri-silicates, one of basic to four of acid oxygen; and sesqui-silicates, two of basic to three of acid oxygen. It is considered that substances which crystallize are assuredly made up of acid and base in proportions that conform to one or other of the above degrees, and not of mixtures of two or more. The phenomenon of crystallization is exhibited most conspicuously by the middle members of the list, being confined mainly to the singulo- and bi-silicates, neither the extremely acid nor the extremely basic compounds being found in nature; and we may remark in the artificial production of silicates a tendency on the part of acids and bases to unite in certain prescribed proportions when suitable conditions exist.

The classification and discussion of slags are often attempted from the same standpoint, that is, the oxygen of the acid constituent or constituents is compared with that of all the basic ones, as if to ascertain the fact of the silicate degree of the slag considered as a whole. Thus we hear of bi-silicate slags or tri-silicate slags, by which is meant the relative acidity of the whole compound, or the consideration of the compound as a class analogous to simple silicates. Little or no light is cast upon the subject of slag constitution by this method, and it is rare indeed that an analysis can be found that will yield results closely approximating any recognized degree of acidity. Even in the case of slags that are devoid of alumina, a substance that more than any other disturbs our calculations, it is common to find analyses indicating that the ratio of basic oxygen to acid oxygen may be as 9 : 10, as 7 : 11, or as 4 : 3, and so on, but rarely as 1 : 2, or as 2 : 3, which would conform to the conventional silicate types. An analysis, for example, may show basic oxygen as 11 : 10 acid, and this will be stretched to prove that the slag is a singulo-silicate. This is merely a mental exercise with no true relation to the facts, and without useful influence on metallurgical improvement. The reasons are, in the first place, that the analyses on which such calculations are commonly based are too lacking in exactness to permit of close discrimination; second, that the functions of several of the ordinary constituents of slag are not well enough understood; and finally, that the different bases do not often combine with the acid to form compounds of the same acidity in any given slag. Accordingly, silicates of different degrees of acidity may co-exist in the same slag. We may deduce from an analysis, for instance, that a certain slag should be classed as a sesqui-silicate, because its ratio of acid to basic oxygen is as 1.5 :1, but it is more likely to be made up of a portion of bi-silicate mixed with a portion of singulo-silicate. Under conditions that will allow the different constituents to group themselves according to their preferences, as in the pyritic furnace, singulo-silicate of iron is formed, and bi-silicate of lime. This may be inferred from what seems to be fact, namely, that all the other heavy metals, whose action in several re-

spects is analogous to that of iron, will likewise form singulo-silicates under similar circumstances; and that the other alkaline earths, such as magnesia and baryta, will form bi-silicates under the same circumstances. Most pyritic slags, at least those containing a notable quantity of lime, together with ferrous oxide, would be classed as sesqui-silicate slags when the analysis is exact enough to enable any reasonable conclusion to be drawn; but, as a matter of fact, they are made up, as observation shows, of a mixture of singulo- and bi-silicates. It should be borne in mind, therefore, that the usual designation of slags by their degree of acidity is purely conventional, and that notions of their internal constitution, when based upon such calculations, are untrustworthy. The subject, for reasons that have already been suggested, is a difficult one, but it is made easier as more reliable analytical data become available.

On the introduction of pyritic smelting a better inkling was obtained as to the composition of slags, considered with regard to the different silicates contained in them. Their ultimate composition was fairly well known before, but not the way in which the acids and bases were grouped, nor is this thoroughly known now. The behavior of several components has eluded observation and test. In the pyritic furnace an ample amount of iron in the form of sulphides is always at hand, and it can make its escape either in the form of matte or of slag. Unsaturated silica, meeting the fused sulphide, decomposes it, giving rise to the singulo-silicate of iron, which is the main ingredient of such slags, and is sometimes almost the sole one. By comparison of many analyses of pyritic slags the conclusion that seems necessitated is that the silicate molecule contains two atoms of ferrous oxide in combination with one atom of silica. With this we have made a notable advance in slag interpretation, especially as other facts point in the same direction. Given a pyritic slag containing only ferrous oxide and lime as bases, the degree of acidity of the lime silicate is easily ascertained. This proves to be the bi-silicate, in which one molecule of lime is combined with one of silica.

With these two facts in mind we advance to the consideration of slags resulting from other processes, some of which follow the same law. A good deal of difficulty is found, however, in some particulars. On undertaking to compute from the analytical data the rational composition of a slag, that is to say, the proportional weight of the silicates present, it is ordinarily found that there is either an excess or a deficiency in the ingredients. Thus, there may be found two or three units showing more silica present than would correspond with a singulo-silicate of some particular base, whereas it would fall, perhaps, six or eight units short of being enough to form a bi-silicate, or the ferrous iron, the lime, or the magnesia, or something else may be in excess. It is rare indeed to find the elements existing in the precise proportion necessary to form normal, or what might be called 'standard', silicates, which must conform to the law of multiple proportion. What explanation can be advanced to meet the case? The impossibility of attaining mathematically exact results by any chemical method is well understood, for the analyses of slags and even of the great bulk of mineral analyses are not much better than tolerable approximations to the truth. Hampe, in 1870, did not detect the magnetic oxide of iron in his ferruginous lead slag, although subsequent investigations have shown it to be almost universally present and uncombined. Among the analyses collected by Dana to show the composition of natural minerals, scarcely one conforms exactly to the chemical standard, that is, to the constitution as indicated by chemical principles. It would appear then that native minerals as well as slags may fail to conform to strict theory, and instead of being examples of perfectly constituted silicates, phosphates, and the like, they are mixtures of normal substances, or else they are heterogeneous compounds in which there is no definite ratio between acid and base. It is natural to look upon slags therefore as containing a portion of standard compounds of recognized basicity mixed with substances in which the principle of chemical proportion does not exist. It has caused great annoyance to scientific metallurgists that they have never been able to detect the precise manner and rate of combination governing slag formation, but from a practical point of view it matters little. No practical results flow from the slight excesses or deficiencies in either base or acid, for, so long as a mineral is fusible, it serves all the purposes of a favorable ore-constituent in the charge. What is known about slags is almost entirely empirical and the working limits of furnace slags are well known.

Aside from the considerations named above, the unforeseen and unknown activities supposed to reign at higher furnace temperatures have always furnished a potent, if imaginary, obstacle to the complete understanding of the modes of combination. Chief of all the factors is the remarkable solvent power of molten slags, enabling them not only to dissolve and mingle in an apparently homogeneous fluid, but also to absorb other bodies of the most unlike kinds, regardless almost of their differing constitution and specific gravity. This extraordinary solvent power, with the resultant miscibility so annoying to the investigations of the chemist and the physicist, is the tendency that, more than any other feature, makes smelting possible. If the silicates and other compounds in slags could be formed only on the plan of definite proportions, whereby the inevitable excesses of one or another component could not be taken care of, we could not imagine successful smelting to be carried on at all. To illustrate this point, suppose, for example, that there is a fused portion of lime silicate in which the proportions of the two ingredients are as their atomic weights, that is, as 56 of lime to 60 of silica, thus forming the bi-silicate; if to this a little lime or silica be added, a new mixture or compound will be formed, the previous ratio of base to acid thereby being disturbed, but the mixture will remain as fusible as before if the addition be not too great, and the resulting slag will not be changed in its apparent physical condition. The addition of silica to an amount less than 60 parts produces

the tri-silicate, but any intermediate quantity will be absorbed as well, although the analysis of the resultant slag will conform neither to the constitution of a bi-silicate nor a tri-silicate. The question under consideration is the seemingly unpractical one as to the form of combination of the added substance. Are there intermediate silicates other than those that appear in nature and those that are discussed in chemical textbooks? Innumerable fusible mixtures are found, regarding which nothing is known except that they are detected in the analysis of slags. There are two aspects in which these and other salts occurring in slags may be viewed: first, they may be regarded as silicates formed at the furnace temperatures, existing as indefinite chemical compounds under conditions dissimilar from those explained by the laws of definite proportion; or, second, they may be considered as mixtures of definite silicates 'in solution', whatever that may be. It is probable that, just as glass is known to be a mixture of silicates existing as colloids, so the explanation of much that is found in slag-making must be sought in the principles of colloid chemistry. From a practical point of view it makes little difference which side prevails. It is enough for the practitioner to know that slags of widely differing content of one element or another are fusible and otherwise suited to his demands. While no one can deny a tendency on the part of the major constituents to group themselves in accordance with the law of chemical proportions, neither can he on the other hand fail to recognize the existence of important portions that seem to exist in defiance of such laws. In explaining this Ledebur and others have taught that slags are to be considered as solutions rather than as complete chemical compounds, a view that is applicable at least to a part of every industrially formed slag. Ledebur's opinion, however, does not answer the question; it only removes it a step further; for if there is anything to be gathered from the actual work of slag-making, it is the conception that, although the law of definite proportion prevails, under some conditions, giving rise to recognized classes of compounds, others are produced that are intermediate in composition. In pyritic smelting, and there only, the slag-formers have an opportunity to assert their preferences, and there we find evidence of a strong tendency to assume the simple relations demanded by chemical theory. In every other case the slag-formers are grouped by force, as it were, that is, they are compelled to combine by the powerful agency of heat. I have accumulated and studied a large number of slag-analyses from no less than 13 pyritic works, the great majority of which bear out my conclusions as to the mode of combination of the slag-constituents, after making reasonable allowance for the inaccuracies of analytical work. On the other hand, there are a few that seem to contain excesses or deficiencies of components, for which there is no present explanation, unless it may lie in the appearance of the silica as free quartz, a not uncommon thing in any form of smelting. In one plant under my charge I noticed the constant discharge of unmelted grains of quartz in a slag that, when separated from them, was found to contain the proportions conformable to theory. The inclusion of such acid grains in the sample chosen for analysis would evidently produce inaccurate results. Another explanation is necessary for a different class of analyses, showing deficiencies of silica in pyritic slags. We may conjecture that this might have been caused by the presence of large amounts of magnetite, which is found in many slags, and is a frequent product of pyritic work. When estimating silica the smelter-chemist is apt to take too much for granted. He often dispenses with a fusion when it is needed for accurate work, and after weighing the silica he may neglect to test it for certain impurities that experience teaches are often present. Whole series of analyses have proved to be unreliable through disregard of simple precautions: small residues of silver, sulphate of lead, and sulphate of baryta, vitiate many an otherwise unexceptional estimation of silica, and it may be that some of the excesses of that substance in slag-reports are due to this cause. We need not go so far as some in claiming that the temperature is such a controlling factor that different silicates are formed at different temperatures. There is no proof of this, and the doctrine that in pyritic slags the iron exists as the singulo-silicate, while the lime and magnesia are present as bi-silicate, is founded on the chemical composition of the slag and not upon any assumption as to their temperatures of formation. The remark of a distinguished metallurgist that "the pyritic furnace chooses its own slag" was not a happy one, in that it seems to set at naught the influence of chemical laws. It would have been more exact to have said that the silica in the pyritic charge chooses its own partners, because it is only in this furnace, and in the copper converter, that it has the unhampered opportunity to attract in chemical proportion the constituents with which it would ally itself.

RUST-PREVENTION for small machine parts may be accomplished by applying iron phosphates to the iron or steel surface. After thorough cleaning, the articles are immersed in a bath containing ferric and ferrous phosphates, with a little manganese di-oxide, and, at the temperature of boiling water, they are left until hydrogen is no longer given off. The articles are then air-dried, when they may be treated with mineral oil, or painted, japanned, or otherwise finished. As the phosphate surface is attached chemically to the metal, no rust forms even in cracks in the paint.

A NEW HIGH-SPEED ALLOY STEEL, containing a high percentage of cobalt, has been invented. According to a patent (U. S. 1,233,118), which James H. Parker, of Reading, Pa., and B. H. DeLong, of Springmount, Pa., have obtained and assigned to the Carpenter Steel Co. of Reading, the new alloy contains 30% cobalt, besides 2% vanadium, 3.5% chromium, and 12% tungsten. The carbon content is 0.35%. While the patent covers a range of composition, the foregoing is stated to have given satisfactory results.—'The Iron Age.'

Construction of Slime-Dams

By JAMES E. THOMAS and E. A. OSTERLOH

*The type of construction for reservoirs that would give the greatest security would be that in which the retaining walls were built of dry material to the ultimate height required before putting the dam into commission, such walls being of the usual trapezoidal section, with the base proportioned to the load. As slime-dams, however, in the majority of cases have to be built of the slime itself, the most that can be done is to endeavor to make the outside walls of suitable thickness, using the coarser slime particles, and avoiding an excess of moisture. The site selected for the dam having been surveyed, a trench should be dug at least three feet wide by one and a half deep along the line which the toe of the outside wall is to follow. The object of this trench is to serve as a preliminary channel for conducting the slime-pulp and also, in some measure, to key the walls to the ground. The earth from this excavation should be thrown to the outer side. The pulp from the tailing-discharge pipe should be led along the trench in one direction, that is, either to the right or left of the pipe, which should be at right angles to the line of the trench until it will no longer flow. It should then be led in the opposite direction, and the partly dried slime from the first portion shoveled out and packed to form a channel at least 21 ft. wide, the lower outside edge of the wall thus formed coinciding with the outside line of the trench.

When the slime in the dam has reached a height of about two feet above ground-level L-shaped launders should be installed at suitable places to drain the excess of moisture from the surface. These launders should have a section of approximately 2 ft. 6 in. by 11½ in. inside, and arranged so that slats 2 by 1½ in. can be dropped into guides in the vertical portion facing the the middle of the dam. The guides should be supported at intervals of 12 in. by horizontal struts nailed inside the launder. It is now possible to allow the pulp to flow from any part of the surrounding channels to the interior of the dam. The following system of control has been found to give satisfactory results: The pulp is allowed to flow along one channel to the other side of the dam farthest from the inflow, and is there led through the inner wall by means of short lengths of pipe to the interior of the dam. When the lower end of the channel becomes choked another opening is made nearer the inflow, and so on until the whole channel is full. The same procedure is then followed with the other channel. Meanwhile, the slime in the first channel is dug out and packed on the existing walls. As the outer walls rise they are stepped back about six inches every two feet in height and trimmed to form an angle of 50° with the horizontal. The stepping renders any portion of the walls easily accessible for inspection and repair. Make the walls straight, with the corners well rounded. This ensures that the walls will receive thorough inspection, and it enables any tendency to bulge to be quickly detected, so that precautions can be taken to prevent the walls giving way. This may be effected by isolating the suspected portion from the rest of the dam, making a temporary channel farther in, while the repair is in progress, by making a new channel some distance from the one abandoned. In bad cases a new supplementary outer wall must be built from heavy slime. The flow into the dam from main channels should be so regulated that any superfluous water or solution is kept well away from the walls and not allowed to remain too long at any one drainage launder.

In order effectively to conduct repairs we recommend that two adjoining dams be used alternately and kept nearly at the same level. Then, if extensive repair to one dam be required, no inconvenience will be experienced in disposing of the tailing that is arriving from the slime-plant, and ample time may be given. The solution or water from the drainage launders should be led to a special dam, adjoining the slime-plant, from which it may be returned to the slime-treatment circuit with a minimum expenditure of pipe and power-lines. For this purpose a trench of slime may be built outside at the base of the main walls, so that the solution will gravitate toward the slime-plant. This trench to some extent acts as an anchor for the toe of the outer walls. It will be evident that, as the vertical portion of the drainage launders and the outer walls approach one another, arrangements must be made to carry the launders farther toward the middle of the dam. This may be done by attaching another L-shaped launder to the top of the first, and so on, as the level of the slime in the dam rises. We find that a length of 12 ft. is most convenient for the vertical launder, with 24 ft. for the horizontal portion. If the inner walls of the main channels are kept within a foot or so of the vertical launders, the fitting of slats becomes an easy matter. It also enables close observation to be kept on the interior of the launder for any broken slats.

When starting again to build up a dam which has not been used for some time, it will probably be found that holes have formed, causing leaks at unexpected places in the outer walls. It is useless to try to stop such leaks from the outside, but it can be done from the inside by allowing nothing but slime to pour into the hole, meanwhile working a shovel at the inlet to cause the sides to collapse and to choke the hole lower down. It has been noticed that walls built in the manner described show comparatively little erosion even after the heaviest rains. This is partly because the fine sand in the heavy slime acts as a binder. Care must be taken, however, that the amount of sand present is not excessive or the walls will crumble away when dry. Slime with 1.5 to 2% fine sand yields a heavy portion suitable to making the outer walls. A moisture-ratio of 1 to 1 is sufficient when discharging slime-pulp. Two dams with a total circumference of 6000 to 7000 yd., built in the manner described, will be found sufficient to receive the tailing from a plant capable of treating 50,000 tons per month.

*Abstract: Chem., Met. & Min. Soc. of S. Afr.

Notes From the Front

By Capt. R. HODDER-WILLIAMS

*There are two advantages in speaking first: one is that, when it is all over, you can enjoy your pipe, and the other is it gives me a chance to get off my only story. This story is told of the very early days of the War, when Kitchener's original 100,000 were training hard in England, and they were getting all sorts of funny people into the ranks. In one battalion of a London regiment, there happened to be a large number of Stock Exchange men, men of about 30 years. These fellows, of course, didn't know anything about army discipline and cared less, and the first few days they were having a great time, but they were pulled up with rather a rude shock when they received, as new company commander, a boy of 18 who had been given a commission when the War broke out. He had rushed into France, been wounded at the Marne, returned to England, and very shortly was back training one of these new battalions. He had gone out as a second lieutenant, but as he had had some war experience, they made him a captain, and this boy proceeded to give them general hell all around, and they didn't altogether like it. So, after a time they hit upon a phrase which they took from a well-known book, well known even to stock exchange men; the phrase was "a little child shall lead them," and this phrase went up and down the ranks all day long. They sang it as they marched, and passed it up and down the line, "a little child shall lead them," and the officer took no notice of it at all. In the afternoon, on parade, again this refrain went up and down the line, "and a little child shall lead them." Still the officer took no notice. It went on until the end of the day. At five o'clock he called them to attention and announced, "Training for tomorrow; there will be a route march; it will be a very long route march; we shall go 26 miles; we shall go in full marching order and we shall carry rifles; we shall carry ammunition; we shall carry everything we shall need; it is going to be very hot and we are going 26 miles; and a little child shall lead them—on a horse."

You will perhaps be a little surprised to know that I feel as one fallen among thieves. The infantry-man regards the mining engineer with all the loathing that is to be expected of him, considering their relative duties in the front line. Of course all engineers—sappers, as we call them in the British Army—are a confounded nuisance to the infantry-men anyway. They come and tell us what to do and then leave us to do it; but the worst of all is the mining engineer; he has become a tunneling company out there, and if there is anything worse than a tunneling company, I want to see it.

The tunneling company works underground, but something has to come out of the tunnel. Do the tunneling companies take their earth away? Oh, no! That, according to the tunneling companies, is exactly what the infantry are for. The earth comes out in sand bags; it is heavy and wet, and you may leave it there, but if you do, one of several things will happen; in the first place, it will stay there because it can't move itself; in the second place, it is sure to block up the trench because the tunneling company waits on no man; in the third place, the sand bags will come over the top of the parapet and the accumulation will be duly noticed by our friends on the other side, and having noticed it, they will duly proceed to demolish the sand bags—all very nice for the tunneling company, 40 or 50 ft. underground, but pretty rotten for the infantry; so you see, of two evils the lesser is to take their beastly sand bags and clear them away, which takes a long time and is hard work; so I hate all mining engineers.

I wish to say a few words a little more seriously. There is only one thing that counts in the soldier's life in this War, as in any other, and that is discipline. There is a lot of talk about not needing the German discipline. That is absolute buncombe; you must have just as good discipline as the Germans have before you can hope to win the War. There are various ways of getting discipline; we are after it in a different way from theirs. So far as possible, we try to make men understand the whole principle of self-discipline, but do not, for a moment, think you can succeed in this War with less discipline because you come from North America. The only thing that will happen to you, if you have less discipline, is that you will get killed. The only way you can possibly hope to win the War is to have discipline at least as good as the Germans. I have a perfectly good reason to dislike the Germans, but they have a superb discipline, and that discipline extends far beyond the army. The very fact that all this fuss was made over the first real strike they had a few weeks ago, and the speed at which it was put down, is sufficient proof that the German people are disciplined.

It is extraordinarily common over here to hear people say, "We are all in it, this is a people's war," etc. It rather reminds you of Robert Louis Stevenson's phrase, "A man should not live on bread alone, but principally on catch-words." A good many of us are inclined to live on catch-words. Do we realize just what being 'a people's war' means? It means that the American people have got to discipline themselves and not leave all the discipline to the soldiers. You cannot begin to win this War until you have all America fighting all Ger-

*A speech made at the War Smoker of the A. I. M. E., New York, on February 19, 1918.

many. Don't ask American soldiers and American sailors to fight the German people; they can't do it. We will look after the German army, but it is up to you to help look after the German people. The German people, whether willingly or not, are mobilized against us; are the American people mobilized against the German? The vital importance of discipline everywhere I think is beginning to be felt, but rather slowly. Of course you can imagine that labor strikes make a soldier pretty mad; when soldiers go on strike, we get shot for it. There is lack of discipline in Canada as well as in the United States and in other quarters, and in other walks of life and in other professions besides labor; and the question is whether the people are going to settle down to the disciplining of themselves, without which the winning of the War is absolutely hopeless.

What is discipline, gentlemen? It is something the outward and visible sign of which may be saluting, and a smart uniform, and obeying orders, and so on; but its inward grace, more important than that, enables us to stick at things whether they are pleasure or not, and not to count the cost. It may seem easy, in the excitement of battle, to forget the cost, but it is not easy, because you see what is going on. The time comes to almost everybody as it came to me on the 15th of September, 1916, to realize, if you are a leader, that all you have to do, all that you have been doing through the gruelling of the last two or three years, is going to depend absolutely on the discipline of those men behind you. As we went forward, everybody was having a great time; suddenly we were absolutely at the mercy of the German machine-guns, and there was nothing to do but to rush them. Can you imagine the feelings of a man as he goes ahead to lead his men forward, who knows without ever turning his head, without ever hearing or seeing a man, that those men are right behind him, trying to get in front of him all the time, to get at that machine gun? That is discipline. We got the machine-gun, and the price we paid was perfectly terrible, but it is being paid all the time. If I have any message to give you gentlemen in a profession in which I imagine discipline counts a great deal, it is just to ask you to spread the gospel of discipline outside the Army.

ZIRCONIUM in sand may be determined as follows: Fuse the sample with NaOH and Na_2O_2 and remove the SiO_2 and the metals that come down with H_2S, in the usual manner. Faintly acidulate the solution with H_2SO_4 and add H_2O_2 until there is no further change of color, after which make up the solution to a definite volume and remove an aliquot part representing about 0.1 gm. ZrO_2. Add to this portion 10 cc. conc. H_2SO_4, and also some H_2O_2; then dilute until the H_2SO_4 is about 10%. Precipitate the zirconium by adding 10% sol. of Na_2HPO_4. Wash the precipitate with dilute H_2SO_4 by decantation as long as any color can be removed, and then work up with the least necessary amount of water in a beaker and dissolve in 25–30 cc. boiling concentrated H_2SO_4. Pour this solution into 300 cc. of water; add H_2O_2 and re-precipitate with Na_2HPO_4. As it is impossible to wash this precipitate completely, it must finally be dried and fused with NaOH. Digest the fused mass with water, acidulate with HCl, filter, wash, dry, ignite, and weigh as ZrO_2. Thorium and titanium are completely separated by this procedure.—'Chem. Abstr.'

Tests for Molybdenum

In a circular on molybdenum, issued by the Colorado School of Mines, the following tests are summarized by Harry J. Wolf:

1. Treat a small quantity of finely powdered ore with 5 cc. of concentrated nitric acid. Evaporate to dryness. Treat the residue with 0.5 cc. of concentrated sulphuric acid. Again evaporate to dryness. If molybdenum is present an ultramarine blue color develops in the residue on standing from 2 to 12 hours.

2. Fuse the finely powdered ore with equal parts of sodium and potassium carbonates and a small amount of potassium nitrate. Powder the fusion and dissolve with hot water, and filter. Acidify the filtrate with hydrochloric acid, boil, and add potassium or ammonium thiocyanate, and a small piece of metallic zinc. If molybdenum is present a bright cherry-red color rapidly develops, which disappears on standing in the presence of the zinc. If hydrogen peroxide is added to the solution immediately after the cherry-red color has developed, the color disappears, returning as soon as the peroxide has been reduced. If the amount of molybdenum present is known to be small, this test may be more delicate if, immediately after the thiocyanate and zinc have been added to the acidified filtrate from the leached carbonate fusion, the solution be shaken with a small volume of ether. The color will be intensified as a golden brown in the ether ring that forms at the top of the liquid on standing.

3. Molybdenite gives off sulphurous fumes when heated in a closed tube, and a pale-yellow sublimate of molybdenum trioxide is formed. The mineral is infusible before the blowpipe, and imparts a yellowish-green color to the flame. On charcoal it gives sulphur fumes and a slight sublimate, yellow while hot and white when cold, and deep blue when touched with the reducing flame. It is soluble in strong nitric acid, leaving a white or grayish residue. It gives a blue solution with sulphuric acid.

4. Wulfenite decrepitates and fuses below 2 before the blowpipe; yields a metallic lead when heated on charcoal with soda; with salt of phosphorous it gives a yellowish-green glass in the oxidizing flame which becomes dark green in the reducing flame. With borax in the oxidizing flame it gives a colorless glass, which, in the reducing flame, becomes opaque black or dirty green. Strong hydrochloric acid gives a green solution which, when diluted and stirred with tin, becomes deep blue and finally brown. On evaporation with hydrochloric acid, if the residue is moistened with water and zinc is added, a deep blue solution results, which persists after dilution.

Mining in Colorado

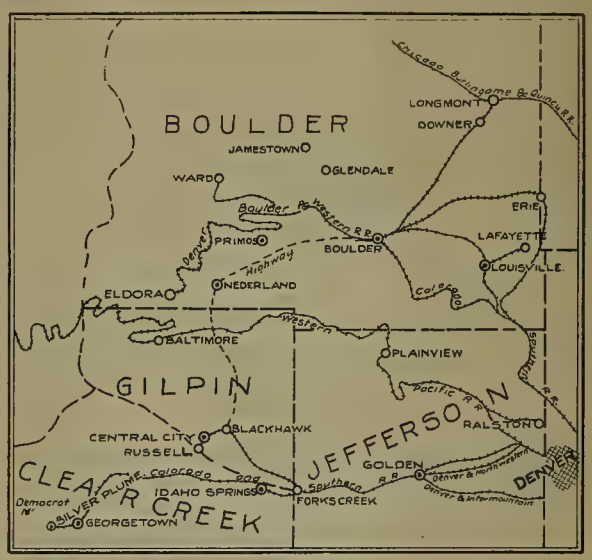
By ARTHUR J. HOSKIN

'High-grading' has been before the courts again. The Supreme Court of Colorado played an April Fool joke on mine-operators in general. The Portland Gold Mining Co. had secured a ruling from the District Court at Cripple Creek to the effect that injunctions could be issued to prevent the purchase by assayers of high-grade ore, precipitate, amalgam, and bullion. Custom assayers were offended by the ruling and carried the case to the Supreme Court, which held that it would be as difficult to prove a violation of an injunction as to discover theft of ore and therefore reversed the decision of the lower court.

Faith in the San Juan region is shown by the various efforts to revive abandoned properties. The Mammoth tunnel, the portal of which is on Cement creek, near Silverton, was driven, years ago, more than 2000 ft. to intersect the Henrietta vein, and was abandoned after the depreciation of silver. It is proposed to re-open and complete this bore. Another tunnel, the Hammond or Treasury, piercing Red mountain from another side, is to be operated now as the Ouray tunnel by Col. Thomas Crawford. The objective is the Tomboy vein, which it will cut at a depth of 1000 ft. lower than any existing workings.

Everybody in the San Juan rejoices over the success attending the acquisition of the Sunnyside properties by the United States Smelting, Refining & Mining Exploration Co. This subsidiary, the Sunnyside Mining & Milling Co., is reported to have expended nearly one million dollars in re-modeling and newly equipping the mine and mill. The mine has been worked almost continuously since 1875. The flow-sheet of the mill now includes automatic scales, steel bins of 1000 tons capacity, automatic samplers, pan-conveyors, Marcy ball-mills, and Dorr classifiers. Within a month the Camp Bird tunnel should reach its main vein. During March the heading advanced 515 ft. Plans call for drifts along the vein and raises to connect with old workings 500 ft. above. The bore has cut a dozen mineralized veins, thus proving, better than ever before, the true character of the San Juan fissures; the lowering of water levels in various shafts in this district demonstrates the porosity of the ground.

Gilpin county is distressingly quiet—at least that is the impression one obtains from a hasty trip. There is activity underground that is not manifest on the surface for the reason that some operations are conducted through tunnels with portals at Idaho Springs in the adjoining county of Clear Creek. At the same time this famous old district is not making the showing it should. An analysis of local conditions shows that Gilpin is in a state of somnolence from which it cannot emerge until modern ideas of mining, backed by capital and engineering talent, are introduced. It is inconceivable that the district is exhausted. Criticism may well be aimed at the wasteful methods of mining—and especially of milling—followed during the palmy days of this county, but the time has come when the mines must be worked at depth for low-grade sulphide ores, and this means radical changes in the dressing of ores. Without working deeper in the old mines, millions of tons of low-grade ore might be salvaged if the district had modern mills. Why is flotation not introduced? Here is a field open to wide-awake investors. There is a most interesting history associated with Black Hawk and Central City. It was

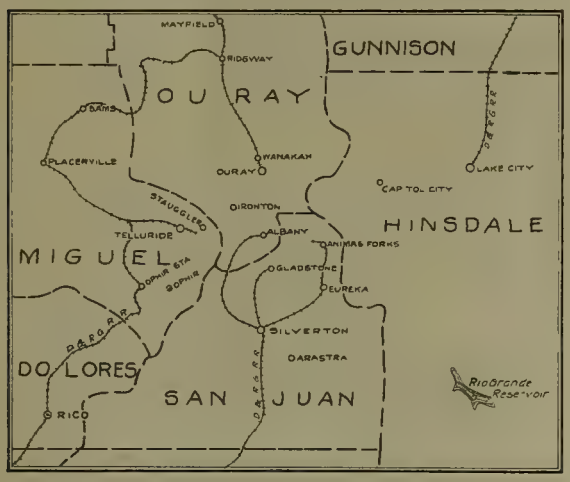


PART OF NORTHERN COLORADO.

here that the first gold ore in place was found in Colorado.

Although little is heard about tungsten mining in Boulder county just now, the fact remains that there is much activity in this kind of mining. The Conger and Wolf Tongue properties continue to produce good tonnages. The Long Chance mill is treating tungsten ore from its own mine. Warren Bleecker and R. D. George are prominent in the promotion of a company that has taken over the Lucky Two and other tungsten mines, the ores from which will be concentrated and reduced in a complete plant at Boulder. Another tungsten company is headed by George Bland, son of 'Silver Dick' Bland, running partner with one William Jennings Bryan in 1900. Instead of the industry lagging, as some have imagined, Boulder county probably produces one-half the nation's tungsten.

We are reminded of this county's resources in other minerals. Years ago Boulder bragged about her silver mines and gold mines. The district has experienced much the same lethargy as prevails in Gilpin, but it is certainly ahead of its neighbor in convalescence. A peculiarity of local ore deposits is that the several metals are not closely associated. One vein may produce rich gold ore with almost no silver content, whereas a near-by vein will carry rich silver ore with perhaps only a trace of gold. Tungsten veins intermingle with the other lodes. Precious-metal orebodies may carry small percentages of lead or of copper or of zinc, but such instances are uncommon. Among the once-famous silver districts is Caribou. Here an old mine is being re-opened by H. F. Corfield, who, last summer, made a valuable strike in the Congo Chief. George W. Teal, mining engineer, is managing operations at the Slide gold mine



THE SAN JUAN REGION.

and mill at Gold Hill. The mill was erected last summer and tested the mine-dump. Underground development will proceed as soon as the mine is unwatered.

Any reference to Boulder county should include the resources of the plains east of the foothills, for this area is rich in coal and petroleum. Many wells were drilled for oil in this territory fifteen to eighteen years ago. While no particularly large flows were encountered, the 'crude' was always of exceptionally high grade. A number of these old wells still produce a few barrels of oil daily at no cost to their owners. The State Geologist and Earl W. Wagy, petroleum technologist for the U. S. Bureau of Mines, agree that the field was never properly proved, it being highly probable that the 'true' or substantial oil-sand lies at depths greater than were reached by any of the old wells. Mr. Wagy recommends the drilling of wells to depths between 2500 and 4000 ft. Agents of several strong oil companies have been quietly securing options on agricultural tracts and preparing for new petroleum exploration. The Boulder Commercial Association has taken a stand against questionable projects and the ranch-owners are following the example. Eight years ago a Boulder assayer, who had invented a process for securing greater quantities of gasoline from petroleum, promoted the United States Refineries Co. He readily disposed of stock, spent money, erected a refinery near Boulder with part of the company's funds, mismanaged affairs generally, and finally escaped to Europe, where he still lives. The company passed through re-organizations until it finally became the American Oil Processes, Ltd., of London. Within the past year it installed a tankage plant and five auto-filling stations within the city of Denver. Recently these Denver units and the Boulder refinery have been taken over by the Apex Refining & Drilling Co., which owns productive wells in Wyoming. Under the direction of Leslie R. Steel, formerly with the Midwest Refining Co., the refinery is being modified into a cracking-plant. Its present capacity is 500 bbl. per day.

The Colorado section of the American Institute of Mining Engineers held a profitable session on April 2 at the Denver Athletic Club. This meeting included a banquet and reception in honor of the three principal officers of the Institute. Sidney J. Jennings, president, spoke upon the patriotic work accomplished by members and dwelt upon the opportunities open for more members. C. W. Goodale, first vice-president, spoke along similar lines, specifically outlining recent interviews held with numerous war-boards and committees at Washington. Bradley Stoughton, the secretary, described the systematic manner in which his office is fitting members into various branches of war service and he called for volunteers to fill vacancies. He advocated the fixing of an annual itinerary of the Institute officials to the various sections in order that such visits may be conducted expeditiously. His announcement of a desire by certain members to have the name of the Institute changed so as to include metallurgists elicited spirited discussion. The title 'American Institute of Mining and Metallurgy' being suggested, it was pointed out that the profession of mining engineering covers all technical branches of the industry so that, if a change be made to satisfy the metallurgists, it should simultaneously be made to recognize geologists, manufacturers, chemists, and assayers. This matter will probably come up for action at the Colorado Springs meeting in September. George W. Taylor, of the Portland Gold Mining Co., announced tentative plans for this annual meeting. Since a majority of visiting members to the meeting will pass through Denver on their way to Colorado Springs, it was decided to devote the first day, Monday, September 2, to seeing Denver. Business sessions will commence at the Springs on Tuesday, followed by a social gathering at the Broadmoor hotel the same evening. Visits to the Cresson, Portland, and Independence mines and to the two mills of the Portland company in the Cripple Creek district will occupy Wednesday. Thursday will be spent at headquarters in business sessions. Plans for Friday, the last day, include excursions to metallurgical works at Pueblo and to the mines at Leadville.

ARSENIC is now quoted at 9 to 17½c. per pound, according to grade.



NEW YORK

Financial.—John Fritz Medal and New York Water-Supply.

The week has ended with a marked appreciation in the average of quotations. War issues of the United States and Allies have uniformly risen, and the majority of security prices have advanced. This has been largely due to the optimistic interpretation of war news, and the gradual diminution of German successes of the Western front. The shares for the most part have been in strong hands, a fact evidenced by the absence of any trace of panic since the German offensive started. The War situation absolutely rules the market. With the promise of dollar silver there was practically no change in the quotations for shares of prominent producers. The third Liberty Loan campaign claims first attention, and the drive is being carried on with a vigor and thoroughness that should ensure success. A satisfactory feature of the returns so far is the increase in the number of subscribers. With regard to the amount, New York is lagging behind with only about 45% of the minimum subscribed. This has been made a reason for a re-doubling of effort on all sides, although the actual amount compares favorably with the sum raised during the corresponding period when subscriptions were being solicited for the second loan. It is thought that several influential prospective buyers are holding back in order to see to what extent it will be necessary for them to subscribe in order to make the loan a success. It is also felt that large subscriptions in the early stages of the campaign would tend to create a feeling of over-confidence among those who were undecided, and who might think that success was certain without their participation. Although New York city has led in previous campaigns, this has been due in a large measure to the fact that the great manufacturing companies have their offices in the city, and swell the local receipts by subscribing here. These corporations will be obliged to meet the year's excess-profit taxes within a couple of months, and this fact may have resulted in a reticence to the new loan to the extent previously possible. It is interesting to note that there has been no slackening in the sales of thrift and war-saving stamps since the loan drive commenced, but rather the reverse. Total sales of stamps since the scheme was inaugurated last December have amounted to over $160,000,000, daily receipts from this source showing a regular and gratifying increase.

The presentation of the John Fritz gold medal to J. Waldo Smith in recognition of his achievement, as chief engineer of the Board of Water Supply of New York city, in the construction of the Catskill aqueduct, was the feature of interest at a recent meeting held at the Engineering Societies building. Mr. Smith is also a director of the Old Dominion Co. and the Old Dominion Copper Mining & Smelting Co. The medal is awarded annually for especial achievement in science, architecture, or engineering, the recipient being chosen by a special committee of the American Institute of Mining Engineers, American Society of Civil Engineers, American Institute of Electrical Engineers, and American Society of Mechanical Engineers. The Catskill water-scheme ranks high in engineering achievement. The need for an ample reserve of water for this city is patent when it is remembered that the population is increasing at the rate of 125,000 annually. The scheme provided for the collection from watersheds delivering to several creeks in the Catskill mountains, with an approximate delivery of 500,000,000 gal. per day. In addition to the necessary reservoirs, the scheme comprised the building of 92 miles of aqueduct to the city's boundaries, for which contracts were let totalling $76,000,000. Four types of conduits were constructed. What is known as the 'cut and cover' system was adopted for 55 miles. This consists of a horse-shoe shaped tunnel of an interior measurement 17 ft. high by 17½ ft. wide. This was of concrete construction, and was buried underneath an earth embankment when completed. Grade tunnels were driven where the contour of the ground suggested it. Twenty-four of these were constructed, covering a total length of 14 miles. These tunnels were also horse-shoe shaped, and were concrete lined. Pressure tunnels were necessary underneath rivers and valleys. Seven of these were constructed, covering a total length of 17 miles. This construction was adopted in the case where the ground was hard enough to permit satisfactory tunneling. The conduits in this case have a diameter of 14 ft., and are circular in cross-section. A vertical shaft connects with the entrance and exit of the pressure tunnel. In those cases where pressure tunneling was impracticable steel piping was used, and 14 miles of this was laid. The pipe was of riveted steel-plate varying in thickness from $\frac{7}{16}$ to $\frac{3}{4}$ in. This was afterward lined with cement mortar. An exceedingly difficult problem was encountered in the work of connecting the boroughs of Brooklyn and Richmond. In this case a flexible jointed cast-iron pipe was used, which was laid in the mud below the neck of water in New York harbor, known as the 'narrows.' Diving work was restricted to a few hours twice a day, as the tide at other times was too swift to permit of any submarine observation. An interesting feature of the work resulted from the need for ample aeration of the water at the reservoirs in order to break up the minute organisms found to exist. For this purpose a special type of rifled nozzle was used, and natural aeration insured by effective spraying. New York water is especially soft and palatable.

ELY, NEVADA

Copper, Manganese, Lead, and Oil-Shale.

The Nevada Consolidated company's works are running smoothly these days, with an average production of 15,000 tons daily. Of this quantity 3500 tons is from the Ruth mine, the remainder from steam-shovel operations. The new hoist, with a capacity of 5000 tons in 16 hours, is in operation at the Ruth mine. Some time since the painters at the smelter demanded 50c. additional per day (now receiving $5.25) or they would walk out. The company not being anxious to paint during cold stormy weather let them walk out, paying them off. The company has finished the 100 dwellings started last fall at the smelter and is now erecting 25 more. The rentals received will not average 6% on the investment, but a more permanent and better class of laborers is secured thereby.

The Consolidated Coppermines Co. is working both sections of its mill. Pumps are in operation on the 1200-ft. level of the Giroux shaft, and work is being carried on from the 1100 and 1200-ft. levels. It is reported that the com-

pany will sink a new shaft between the old Alpha—which is caved—and the Morris shaft. This is much needed, as at present there is no means of egress in case of accident to the Giroux.

The Nevada United company (old Ward), 18 miles south of Ely, is shipping 40 tons daily of lead-silver-iron ore. A large tonnage is said to be available.

Holmquist is shipping 25 to 30 tons of manganese daily from his property 7 miles south-east of this place. The ore contains 43% Mn. The owner had a good offer for the property last week. Holmquist, leasing on the Keystone claim of Nevada Consolidated, shipped one car last week, quarried from the surface.

A. B. Witcher, from an adjoining property, is shipping 15 tons daily.

Schmidt brothers (Italians), leasing on the Golden Fleece of the Coppermines company next to the Ely-Revenue, have shipped four cars of 45% manganese during the past month.

Shipments are being started from the Hamilton lead-silver district. Lessees during the past winter mined a considerable tonnage. Roads are now in fair order for moving ore. The old stage road north from Keystone to Hamilton will be repaired this season. It has the best grade, but has not been used in recent years. The Federal government will expend $31,000; the State and White Pine county jointly an equal amount. The State Engineer has had this route surveyed during the past month.

Many locations of oil-shale have been made in recent months about 35 miles west of Ely and a few miles east of Hamilton. Local people have organized a company with Arthur Smith as president. E. E. Vanderhoef, superintendent of steam-shovel operations of the Nevada Consolidated, is to be general manager and will have charge of drilling for oil. Sufficient money has been raised for the services of a petroleum engineer to make a thorough examination as the first move.

PLATTEVILLE, WISCONSIN

Summary of Activities of Wisconsin Zinc Co.

The Wisconsin Zinc Co., incorporated under the laws of Maine with a capital of $1,000,000, is at present extensively engaged in zinc mining in this field under the able management of A. W. Plumb, formerly of Denver, Colorado. The company is one of the largest zinc-ore producers. It also operates one of the Skinner zinc-ore separators, and an industrial railway that connects its several properties with the main line of the Galena division of the Chicago & Northwestern railroad. Three mines in the New Diggings district—the C. A. T., Champion, and Longhorn—are producing from 800 to 1000 tons of zinc concentrate per week. A new mine recently developed and equipped is on the Copeland estate, in the Shullsburg district. It made its initial ore deliveries during the third week of March. One of the most consistent producers of the field, from 1912-1918—the Winskill—also at Shullsburg, was exhausted and abandoned on March 16. The equipment will be dismantled and moved. Drills are engaged by the company on various tracts in the Benton, Hazel Green, Shullsburg, Galena, and New Diggings districts. Several prospects are ready for development. Ore from mines to roasting plant, thence to rail, necessitated motor and steam-tractor trains until recently, when the Wisconsin Zinc, Vinegar Hill Zinc, and New Jersey Zinc companies combined to construct and operate at their own expense an industrial spur. Officials declare that this is of great benefit to all. Sales of dressed ore are made in open market to the highest bidder, although the Wisconsin Zinc Co. is a subsidiary of the American Zinc, Lead & Smelting Co., and is in this manner affiliated with the American Zinc Co. smelters, at Hillsboro, Ill., to which point much of the finished ore finds its way. Heavy shipments are made at intervals of pyrite saved as by-product in the separation of zinc ore. The pyrite carries 30 to 35% sulphur. The Skinner roasters were completed in 1916 at a cost of $100,000. They are capable of treating 1000 tons of raw zinc concentrate weekly. From this is recovered 500 tons of 59 to 61% blende. Cleveland-Knowles and Dings separators are largely employed in this plant, also the McDougall furnace. Fifty men can operate the plant per 24 hours. A wet mill was erected during the summer of 1917 to wash out fine and slime. The Overstrom sludge-table is mostly used. The ordinary method of wet concentration employed in the Wiscinson field is regarded efficient enough to eliminate the necessity of saving the small amount of mineral lost in slime. The wet plant mentioned is now standing idle. Between 500 and 600 men are employed by the Wisconsin Zinc Co. Sociological conditions of the workers are given plenty of attention. Wages paid are good, and labor conditions within the past three months show improvement. Mill feed is handled on the can-contract system. Shovelers earn from $3 to $5 each per shift. Power is supplied the company by the Inter-State Light & Power Co. of Galena, Ill. It is steady and good. A telephone system connects the general manager's office with mine foremen underground. Your correspondent, after an interview, learned that no new mills will be erected this season on account of the present ore market. Dividends have been disbursed to June 1, 1917, on an annual basis of 8%. Quarterly payments amounted to $20,000. Quick assets in the field are scheduled at over $1,000,000.

TORONTO, ONTARIO

Coal, and Lignite Briquettes.—British-American Nickel Corporation.

The problem of providing against a shortage of fuel, in view of curtailment and possible entire cessation of supply from the United States, is receiving much attention. The necessity of speedy and energetic action has been impressed upon the public by a recent order of the Dominion Fuel Controller, limiting the supply to consumers to 70% of their normal requirements, and in all cases where hydro-electric power can be effectively substituted, the use of coal for power will be prohibited. Investigations of the Advisory Council for Scientific and Industrial Research having shown the feasibility of producing carbonized briquettes from the lignite of Saskatchewan, as a substitute for anthracite, the Canadian government, in co-operation with the Provincial governments of Saskatchewan and Alberta, has undertaken to establish and operate a briquetting plant in Saskatchewan capable of producing 30,000 tons of briquettes per annum. The cost of the plant, including expense of operation for a sufficient time to establish a practical process, is estimated at $400,000. Of this, the Dominion government will furnish $200,000, the Provinces interested the remainder. The Advisory Council finds that two tons of lignite will produce one ton of briquettes, approximating anthracite coal in heating value for domestic use, in addition to yielding by-products such as oil, pitch, ammonium sulphate, and gas. Meanwhile, some the Alberta coal companies are endeavoring to obtain a market for their output in Ontario, though it is doubtful whether much relief can be expected from this source with the present high freight charges.

Sudbury.—The British-American Nickel Corporation is making good progress with construction of its smelter. About 650 men are engaged. The plan of establishing its refinery in the Sudbury district was abandoned some time ago, on account of the excessive cost of obtaining a supply of power. A site was recently secured at Deschenes, near Hull, on the Quebec side of the Ottawa river, and construction will be proceeded with immediately.



ALASKA

Anchorage.—The Government railroad is likely to be delayed considerably by present conditions. During the season of 1917 there were 6000 men employed, but for the coming season only half of that number are expected. According to W. C. Edes, chairman of the Alaskan Engineering Commission, during the last two seasons, there was practically completed the coastal sections of the line, along which transport conditions enabled work to be done at a number of points at the same time. In the future construction will go straight into the interior, extending the line at most from only two points. Assuming the usual Congressional appropriations become available, the Commission, which still has some doubts about its ability to secure even half the labor force it had a year ago, will centre its effort during the coming summer upon the completion of the main line from Seward to Anchorage, both of which are Pacific Ocean ports on the Alaskan southern seaboard, between which a rail gap of 17 miles now exists. Main railheads in addition will be pushed 40 or 50 miles toward the interior terminal, which is Fairbanks, opening the line approximately from mile 215 to mile 265, distance estimated from the ocean terminus at Seward northward. In Alaska, except in certain places and on certain types of work, the Commission has found that construction is only practical during the summer after May 15. The average scale of wages paid during 1917 would work around $1500 per year, but it actually does not run a year for more than a part of the men, because of the seasonal character of the work. As a side issue to railroading, the Commission operates, on a small scale, coal mines at Matanuska, on a branch line 38 miles from the trunk, and is doing some port dredging at Anchorage, and building docks and coal bunkers at Anchorage and Seward. To date, $23,670,000 has been spent upon the enterprise, out of a $35,000,000 estimate for the total cost, which the Secretary of the Interior has raised to $40,000,000, because of higher costs of labor and materials.

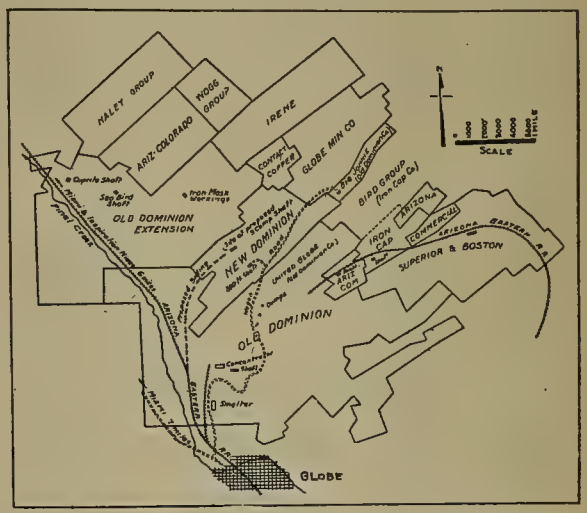
Juneau.—Alaska Gold Mines Co. made a profit of $42,274, after paying interest but before depreciation, during 1917. In 1916 the profit was $112,833. Alaska Gastineau shows a deficit of $792,789, compared with $105,740 in the previous year. Last year, 2,240,346 tons of $1.103 ore was milled, against 1,892,788 tons and $1.193 in 1916.

Kennecott.—It is reported that the Kennecott Copper Corporation is negotiating with the Mother Lode company for acquisition of the latter's property nearby.

ARIZONA

Christmas.—The Gila Copper Sulphide Co., having a mine here in Gila county, and another in Pinal county, is in the hands of a receiver, Allan Forbes of Boston. Company is said to have defaulted in payment of $690,000 on mortgage bond that matured April 1. The mines at Christmas have been under bond to the A. S. & R. Co.

Globe.—The Superior & Boston Copper Co. in 1917 reports a revenue of $383,541, of which $340,198 was from ore sales. The year started with a balance of $176,107, and ended with $141,577. The superintendent, A. L. Graham, states that 17,146 tons of ore was mined. Development, including sinking the McGaw shaft 145 ft. to the 1400-ft. level, totaled 2782 ft. A Nordberg 500-gal. pump was erected at 1200 ft., while another is being put in there also. These pumps will have a capacity of 2,000,000 gal. per 24 hours. The cost of pumping was reduced 20%. The labor situation affected operations considerably. New ore on the 1000 and 1400-ft. levels is very promising. Purchase of the Telfair claims adjoining was recommended by George King-



PROPERTY MAP OF GLOBE DISTRICT, ARIZONA.

don and W. X. Osborn. This was done, cash and shares being paid for the 200 acres.

The Moline-Arizona Copper Co. is working 21 claims one mile from the Old Dominion smelter. A shaft is down 415 ft., to be deepened to 800 or 1000 ft. Considerable development is contemplated. Walker & Sons, of Moline, Illinois, control this company, which has a capital of $2,000,000. B. F. Baker is in charge at Globe.

Hill Top.—The Ajax Metal Mining Co., with an office at Denver, Colorado, and mines on Tail creek near Hill Top, is making regular shipments of copper, lead, and silver ore to El Paso. A recent lot of three cars returned 12% copper, 16% lead, and 14 oz. silver. Recent development opened a 5-ft. vein assaying 42% lead, 18% copper, and 24 oz. silver. Equipment includes a 75-hp. Otto gas engine. A 480-ft. Ingersoll-Rand compressor and five Clipper drills from Denver Rock Drill Co. are to be added.

Jerome.—The Verde Squaw is making good progress in its adit.

Jerome Superior's new machinery is at work, save the hoist.

Mammoth.—The Galiuro Molybdenum Co., operating the Childs mine in Pinal county, 11 miles from this place, is to order a mill costing $10,000. Workings total 850 ft., 475 ft. said to be in ore assaying from 0.33 to 10% MoS_2. One

portion blocked out contains 4820 tons of 2% ore. Operating costs are estimated as $11 per ton. W. R. Ramsdell is in charge.

Oatman.—Grading for crushing plant of Gold Road mines has been completed. This plant was purchased from Union Basin company. Rich gold-silver ore has been opened for 75 ft. during stoping, 35 ft. above 650-ft. level of the Gold Ore. The mill is treating 50 tons per day.

Big Jim Consolidated is to develop its Blue Bird property at once.

The mill of the Secret Pass Gold Top Mining Co. is treating 15 to 20 tons per day. Sufficient ore is developed to keep the plant operating for two years.

Payson.—The Mazatzal Mining Co. is operating 16 miles west of this place. A recent report by company's engineer, R. J. H. Bradley, states that House No. 1 adit is in 1000 ft. A fault-vein was cut assaying $4 silver per ton, also House No. 1 vein, 12 in. wide at depth of 200 ft., containing $125 per ton in gold, silver, and copper. Further work proved the body to become poorer when widening to 36 in. House No. 2 vein was also cut, 18 in. wide, worth $19 to $35 per ton. It is proposed to sink a shaft from No. 1 adit to a depth of 500 ft., to cost $75,000, including necessary plant, plus $25,000 for other work. The company is considering buying motor-trucks to haul ore to the smelter, 88 miles distant.

Prescott.—Ore carrying 16% copper has been opened at depth of 68 ft. in Maiden brothers' property in the Thumb Buttes district.

Shaft of the Arizona Copper & Mining Co. is down nearly 500 feet.

McIver, Long, and other Mohave county men have taken over interests of the Kay Copper Co., in the Black canyon. Purchase price was stated as $150,000. Anticipating immediate development, the town of Canyon is active.

Stoddard.—Employees of the Arizona Binghampton Copper Co.—105 in number—have subscribed $20,000 to the third Liberty Loan.

Tucson.—University of Arizona Bulletin No. 81 is entitled 'How to Organize for Safety', by S. C. Dickinson. The subject covers 52 pages, and should be of value to mining companies who have or are contemplating organizing a safety department.

CALIFORNIA

Bishop.—Four mills are dressing tungsten ore in this district, while other companies are developing their properties.

Bolinas.—New mill of the Checto Mining Co. is working three shifts. Ore comes from No. 1 level, but as soon as an electric pump is installed the shaft is to be unwatered. A 3000-ft. flume has been built to carry tailing to a dam. An auto-truck hauls concentrate to the wharf here, also carrying employees back and forth to the mine, four miles away.

Dutch Flat.—W. A. Bliss has acquired the McGuire placers at Lowell Hill and is arranging to build a dam on Bear river. The gravel has been carefully prospected and carries considerable gold.

At the Wisconsin placer mine, W. S. MacDonald is operating with 14 men and extracting rich gravel. The property is a mile below Dutch Flat, and was formerly known as the J. L. Gould.

Folsom.—The Noble Electric Steel Co. is concentrating 60 tons of chrome ore daily near Negro hill.

Grass Valley.—A brief strike for increased wages at the North Star was ended on April 26 when the company granted an increase of 50c. per day, effective May 1. Miners here will now receive a minimum of $3.50. Other mines in the district gave a 25c. rise on the same day.

Ingot.—The Afterthought Copper Co. has 60 men in its mine and as many more in the mill. Only one unit of the flotation plant is working, dressing 150 tons of ore per day. The town is once more prosperous.

Keswick.—The Crescent Copper Co. has been granted permission by the State Corporation Commission to issue 6000 shares, par value $1 per share, to certain persons in exchange for three separate groups of claims near Keswick. The company is also permitted to sell 25,000 shares at par for cash, so as to net 80% of the selling price. Money obtained from the sale of shares is to be used in the purchase of equipment and for development.

Murphys.—The Sheep Ranch gold mine near here is being sampled by a syndicate that has an option.

Nevada City.—The Birchville Consolidated Mines Co. has been granted permission by the State Corporation Commission to issue 125,000 shares of its common stock in exchange for mining properties in the Eureka mining district of Nevada county; also to sell 50,000 shares of its preferred stock at $1 per share, so as to net not less than 80%.

Trinity Center.—On April 19 the Estabrook Gold Dredging Co.'s boat sank, the bow being in 26 ft. of water. The cause is not known yet. Buckets are of 7-cu. ft. capacity. The boat is an old one, and a new one is under construction.

COLORADO

The customary splitting limits as usually agreed upon in ore-buying contracts in Colorado are as follows, according to 'Metallurgical and Chemical Engineering:'

Gold	0.02 of an ounce
Silver	0.50 of an ounce
Copper	0.50 per cent
Lead	0.50 per cent
Zinc	1.00 per cent
Iron	1.00 per cent
Insoluble	1.00 per cent
Sulphur	1.00 per cent

Boulder.—Victor is the newest tungsten centre of this county, 3½ miles east of Nederland. The Wolf-Tongue owns a quarter of the area. In the Victor, Philadelphia, Rinn, and others considerable ore has been opened.

Fluorpsar in large quantities has been extracted from mines in the Jamestown district of Boulder county. The fluorspar mill of Chesboro & Kermack is a success. It is handling 50 tons daily.

Georgetown.—Smuggler mine at Silver Plume is shipping 350 tons of ore monthly to the Hudson mill at Idaho Springs. Concentrate carries 50% zinc, 60% lead, and 150 oz. silver per ton. Rich ore is also shipped direct to smelters. Thirty men are employed.

The Wasatch Colorado company is employing 60 men at the Mendota mine. The 70-ton mill is yielding high-grade zinc and lead concentrates.

In the Terrible mine of the Denbigh Mining Co. are 14 levels 70 ft. apart. There are 35 men employed in reopening workings. No. 11 level is yielding good lead-silver ore.

Silverton.—Ross Mining & Milling Co., controlling the Champion mine, has made sub-leases to Cassagranda & Co. and an independent operator, who have made shipments to the Durango smelter.

The Lackawanna operators, known as the D. L. & W. Mining & Reduction Co., have leased the Silver Lake mill.

The Precious Metals Mining Co. recently reduced its capital from $5,000,000 to $1,000,000.

The Zuni mine has been leased by Jackson & Anderson, who are cleaning out the tunnels, and will drive another to the main vein of the old Zuni mine. The property has been one of the best producers in the district, and is expected to keep up its reputation.

IDAHO

Adair.—The Richmond M. M. & R. Co. resumed hauling of ore by tram last week, about three carloads weekly. Thirty men are employed.

Kellogg.—Caledonia Mining Co. pays 3c. per share on May 6, equal to $78,150.

Kingston.—An option on 1,100,000 shares in the Hypotheek Mining & Milling Co. at 15c. each has been taken by J. K. George of New York, according to J. H. Kern, managing director. The sum to be paid under the terms is $165,000. The option may be exercised on or before August 15. The capital is 2,000,000 shares. The property is in the Coeur d'Alene region, and has been developed to a depth of 1200 ft. The mill is of 200 tons capacity.

Pierce.—The dredge which has been working near here for some years has been moved to Orofino creek near Gold Dollar, and should be in operation in May. H. R. Bailey is in charge.

Wallace.—Labor shortage in the Coeur d'Alene region continues, the estimate being 1000 men.

A joint tunnel may be driven from Beaver creek under Sunset peak to develop the Sunset claims of W. A. Clark and those of the Sunshine Mining Co. The Sunset orebody would be cut at a depth of 1500 ft. below the shaft bottom, which is 1000 ft. deep.

Wardner.—The Stewart Mining Co. contemplates retreating by flotation old tailing amounting to 200,000 tons.

KANSAS

Galena.—Drilling here has proved that the future of mining will depend on deeper work. Several companies did some deep work. The Wayland Mining Co. is an instance of getting ore as deep as 300 ft. The log of one hole is as follows, in feet:

Character of ground	From	To	Thickness
Surface and hard white flint	...	59	..
Softer flint with good ore	59	69	10
Harder flint with good ore	69	84	15
Hard white flint with 'shines'	84	114	30
Soft ground	114	121	7
Hard ground	121	181	60
Lime with some flint	181	234	53
Spar ground with good ore assaying for 40-ft. sample from each 4 ft., making an average of 16.8% zinc	234	274	40
Lime with good flint 'shines'	274	296	22
Lime	296	300	4

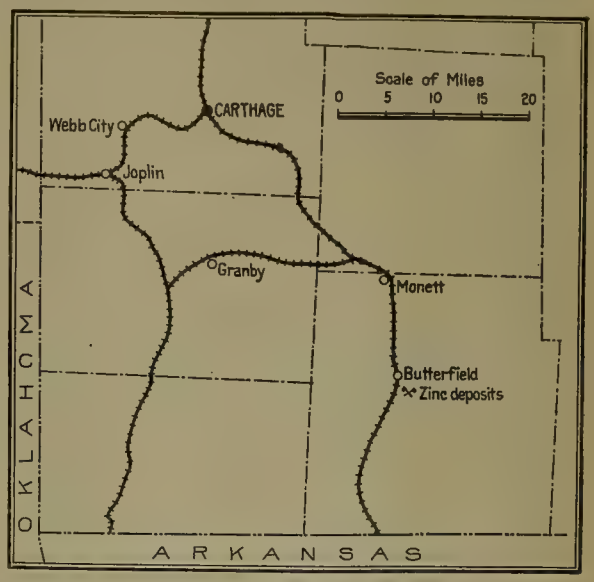
MICHIGAN

Houghton.—Calumet & Hecla is using all the steel suitable in its old coal-dock on Torch lake for making tanks and trays in the flotation department of its Hecla mill.

Mass Consolidated Mining Co. in 1917 received $1,045,502 from copper sales, plus $16,816 from sundries. Expenditure totaled $796,906, leaving a profit of $265,413. Dividends (three of $1 each) absorbed $291,951. After deducting betterments, taxes, etc., the balance carried to 1918 was $321,372. The year started with $449,255. The superintendent, E. W. Walker, states that 4364 ft. of work was accomplished. Miners decreased from 409 in January to 232 in August, then gained to 372 in December. Results were satisfactory. The Evergreen lode yielded a good deal of mass copper. Reserves increased appreciably. The mill dressed 244,671 tons of ore, averaging 16.29 lb. copper per ton, yielding 3,984,616 lb. of copper. The cost was 19.81c. per pound.

MISSOURI

Butterfield.—Drills in this district, about 40 miles southeast of Joplin, in Barry county, have cut good zinc ore—4.47 to 5.12% blende. A new mining field is possible.



MAP SHOWING RELATION OF BUTTERFIELD ZINC DEPOSITS TO JOPLIN.

Ore occurs in blue flint and disseminated formation at depth of 100 ft. It carries no lead. The Missouri Mining & Investment Co. has erected a 250-ton mill.

Joplin.—Production of the Missouri-Oklahoma-Kansas region last week was 9222 tons of blende and 1435 tons of lead, averaging $42 and $81 per ton, respectively. Total value was $502,907, making $7,702,228 for 16 weeks. Oklahoma contributed $326,742 to last week's total.

Waco.—Drilling on the Nicholas land in the Waco-Lawton field has exposed 50 ft. of 40% blende ore.

Tom Hale Lead & Zinc Co. is to erect two mills—250 and 300 tons capacity—one in this field and the other at Douthat, Oklahoma. T. D. Hale of Oklahoma City is president.

MONTANA

Marysville.—The new gold-silver-lead ore in the Bell Boy mine near Marysville is considered the best made here in years. The shoot was found in cross-cutting the vein, which is 40 ft. wide. It was found by lessees at a depth of 150 feet.

In Lump gulch, Jefferson county, the Amalgamated Silver Mines Co. has completed a shaft to 250-ft. depth. A crosscut to the vein, which is 8 ft. wide, shows a streak of silver ore assaying $100 per ton. Control of property recently passed to Denver and Eastern people. The shipping point for this mine is Clancy, two miles distant.

The Mt. Washington mine is developed by a 3600-ft. adit to a depth of 800 ft. Thirty tons of lead ore is sent to the smelter daily, the most that the smelter will take.

Helena.—Stationary engineers are on strike in the Helena district, and mines are being closed.

NEVADA

Alpha.—Ore assaying $80 in zinc and $30 in lead has been uncovered seven miles from Alpha, a station on the

Eureka and Pallisade railroad, by Bryon Wilson, W. S. Rippey, T. J. Dron, and H. P. Herd of Manhattan. The deposit has been opened to a depth of 60 ft. and traced on surface for 2000 ft. Arrangements are being made for shipments.

Goldfield.—At a depth of 750 ft., Grandma Consolidated has cut a water-channel. Sinking continues with an additional shift.

The Montezuma silver district, 10 miles west of Goldfield, is attracting attention by the rich silver-lead ore being mined. The Montezuma Silver Mines Corporation and lessees appear to be getting satisfactory results.

The Pioneer Consolidated Mines Co., at Pioneer, is to be re-organized. Two of the eleven claims have produced a considerable quantity of good ore.

National.—Lessees, Carl Stolfelt and Sam Watkins, at the National Mines property shipped 166 lb. of gold ore, valued at $5000, last week to the Selby smelter. This is a reminder of old times. Other lessees are busy in exploration.

Rand.—Jumbo Copper Mountain company, subsidiary of Jumbo Extension at Goldfield, reports encouraging results. At depth of 300 ft., No. 3 shaft passed through the contact zone, exposing 8 ft. of sulphide ore assaying 5% copper. L. L. Dellinger is in charge.

Reno.—Uvada Mining Co., operating in Esmeralda district of Washoe county, sold ore worth $1260 in 1917. Total receipts were $5861. Expenditure at mine was $3505.

Virginia City.—All mining companies on the Comstock granted a wage increase last week after holding conferences with representatives of the Miners' Union. Miners will receive $5 per day, and shovelers and carmen $4.50. Mechanics and other surface workers will receive a flat increase of 50c. daily. The wage-scale is lower than that prevailing at Tonopah and Rochester, but is higher than at Goldfield and most other camps.

Union Consolidated paid 5c. per share on May 11, making $60,000 for the current year.

Compressed-air locomotives are to be used in the Con. Virginia to haul ore to the Union Con. shaft, whence it will go to the Mexican mill.

NEW MEXICO

Deming.—The Sierra Blanca district, of Sierra county, is noted for the richness of its gold and silver ores. The Bi-Metallic M. & M. Co.'s mine's deepest shaft is 400 ft., with 1500 ft. of development. Ore is worth $27.90 gold and silver per ton. Equipment includes a 20-hp. Alamo gas engine, an Ingersoll-Rand air-compressor and jack-hammer drills. M. S. Nord is general manager.

Kingston.—C. T. Brown, of Socorro, general manager for the Empire Zinc Co., has completed surveys of the old South Percha mines, 3½ miles south of here, and has started development. Rich silver ore is being stacked for shipment.

Mogollon.—Re-building of the Socorro M. & M. Co.'s mill will not be completed until July. It will be on the old foundation and as nearly fireproof as possible, being of steel and concrete. The carpenter-shop, planing-mill, saw-mill, and store-house are finished. The steel frame for hoist is up. This company recently purchased the 29 claims and 40 acres of mill-sites from the Mogollon Gold & Copper Co., so its total holdings are now 1600 acres. The mill will include two Hardinge ball-mills, one 13 by 24 Blake crusher, and one 15 by 20 Blake crusher, two Chalmers & Williams tube-mills, and five pachuca agitators for cyanidation. De La Vergne oil engines are used, four totaling 1000 hp. D. B. Scott, late with Inspiration Consolidated Copper Co., is general manager.

The Mogollon Mines Co.'s greatest depth of workings is 1800 ft. The main adit is nearly 3000 ft. long. There are over five miles of underground workings. Equipment consists of an electric hoist, Ingersoll-Rand compressor, De La Vergne oil-engines, electric power, 40-stamp mill and cyanide plant, capacity being 165 tons per day. There are 125 men employed. S. T. Kidder is general manager.

OKLAHOMA

Picher.—Production of Oklahoma mines last week was 5791 tons of blende and 1004 tons of lead, valued at $326,742.

Black Hawk Mining Co. is moving No. 3 mill of the Onamena company at Duenweg, Missouri, to its property south-east of Picher. Ore is said to carry 25% blende.

OREGON

Gold Hill.—Shortage of skilled miners and millmen prevents resumption of work at the Millionaire, Nellie Wright, and other smaller gold mines in this district. Rich ore has been uncovered from an 80-ft. raise, 400 ft. below the surface, in the Ray and Haft mines three miles north of Gold Hill. This is operated by J. W. Davies of Sacramento, California.

Grants Pass.—The 13 chrome deposits in the Waldo district controlled by R. J. Rowen and associates have 27 auto-trucks employed hauling ore. Five cars daily are sent from the shipping point at Waterville. This quantity is to be increased.

TEXAS

Austin.—J. P. Nash, of the Bureau of Economic Geology and Technology of the University of Texas, has returned from Val Verde county, where he investigated the manganese deposits. He reports that there are two properties being prospected, and 40 carloads is available. The ore carries from 5 to 40% manganese. No estimate of quantity is possible so far. The ore is found mostly in caves, and consists of large porous boulders in many instances. The beds are close to the Rio Grande, and adjacent to the Southern Pacific railroad.

Orla.—Texas Sulphur Co. has finished erecting buildings at its sulphur deposit near here, and awaits equipment ordered. Company owns surface rights to 1331 acres. On part of this land the sulphur beds outcrop and may be mined by steam-shovels. H. M. Tibbett is secretary at Orange, the headquarters.

UTAH

Alta.—The Alta Tunnel & Transportation Co.'s tunnel was in 3228 ft. on April 1, 325 ft. from a point directly under the outcrop of the Prince of Wales vein. An assessment of 1c. per share has been levied.

Dugway.—Preliminary work has been started by the Dugway Smelting Co. Foundations are being prepared and wells sunk for water. The first unit of the smelter is to be of 100 tons capacity.

Provo.—Diamond-drilling is under way in the Bonneville tunnel of Jesse Knight. Face is in 5100 ft. from portal, at depth of 2500 ft., and drill is boring horizontally in ground 1500 ft. from end of adit. So far this adit has found little ore.

Tintic.—Labor disputes here have been settled, but the mines are short of men, probably 30% low.

WASHINGTON

Republic.—Ore shipments from Lone Pine-Surprise company for 21 days in April amounted to 15 carloads. From April 22 daily shipments were to be 50 tons.

Northport Smelting & Refining Co. has purchased the Blacktail claims from the Hope company.

No. 2 diamond-drill hole on the San Poil vein is nearly finished.

Spokane.—The Spokane tin mine on Moran prairie, south of this city, has been bonded to F. C. Bailey and others for three years. There is said to be 8 ft. of ore on the surface. A shaft is down 152 ft. On 100-ft. level 180 ft. of work is estimated to show ore worth $40,000. Nothing has been done since 1907.

CANADA

British Columbia

Princeton.—Pending a decision regarding income-tax, construction of the 14-mile branch of the Kettle Valley Railroad from Princeton to Copper Mountain is to be suspended. W. P. Tierney has the contract.

Revelstoke.—Lanark Mines Co. is to spend $25,000 in constructing a dam and power-plant. Two new shoots of ore were opened in the mine during the winter. W. B. Dornberg is manager.

Sandon.—The Slocan Star Mines is to be re-organized as the Silversmith Mines, with a capital of $750,000. The property is fully equipped.

Victoria.—A seventh interest in Coast Copper Co., subsidiary of Consolidated M. & S. Co., operating on Vancouver island, has been sold by M. W. Bacon and W. E. Cullen to G. E. Snyder and others of Spokane for $150,000. This equals about $5 per share. Development and equipment of property cost $350,000. Ore-reserves above 700-ft. level are 2,940,000 tons, assaying 2% copper and $1.25 per ton in gold and silver. Vein on this level is 24 ft. wide. Railroad survey from Quatsino sound to mine, 12 miles, has been surveyed. J. J. Warren is general manager, and W. M. Archibald mine manager.

The policy of the Provincial government in regard to taxation of mining properties was disclosed on April 19. The Hon. John Hart, Minister of Finance, introduced the bill which, no doubt, will become law. It provides that mines shall be taxed on income or 2% on the assessed value of the ore removed, whichever is the greater. Properties coming under the income tax will be allowed for depreciation of plant up to 15%, the exact percentage in each case being left to the Minister to decide. Salaries paid to directors and officers will be deducted when the recipients are resident within the Province and, therefore, are paying income tax themselves. It also is proposed to exempt from the personal income-tax dividends from mining companies when the tax has been paid at the source. Gold-mining companies will be taxed on profits only, in view of the fact that the price of gold is fixed, while the cost of production has greatly increased. The various deductions just enumerated apply here as well. A tax of 37½ cents per ton is placed on iron ores, but this is more than offset by the bounty of $3 per ton on pig-iron produced in the Province from local ores, and the smaller bounty on pig-iron produced in the Province from foreign ores. All these mining taxes and the deductions affecting them date back to January 1, 1917, and as soon as the amendments are law the taxes for 1917 and 1918 will be levied and collected.

Ontario

Cobalt.—Kerr Lake produced 207,100 oz. silver in March, and pays a dividend of 25c. per share, equal to $150,000, on June 15.

Silver yield of Nipissing in March was valued at $308,048. This came from 94 tons of high-grade and 7234 tons of low-grade ore. The refinery shipped 525,932 oz., partly custom metal.

Kirkland Lake.—First clean-up of the Lake Shore company's new mill gave gold valued at $40,000 from a 23-day run. There are 56 men employed.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Arthur L. Pearse is in New York.

Horace V. Winchell is at Salt Lake City.

Robert M. Thompson is at the Fairmont hotel.

Franklin W. Smith, of Bisbee, is at Redlands, California.

J. A. Martin has left Alaska and is now at Cleveland, Ohio.

C. S. Corbett is with the U. S. Shipping Board at Washington.

W. H. Sirdevan is returning to the United States from Nicaragua.

R. B. Watson has returned from Phoenix, Arizona, to Cobalt, Ontario.

James A. Block is now with the U. S. Coal & Coke Co. at Gary, West Virginia.

James W. Neill has gone with a prospecting expedition into north-western Canada.

Rensselaer Toll has returned to San Francisco, having completed a mill near Kingman, Arizona.

Bernard MacDonald has left for Guanajuato, Mexico, where he expects to remain for several months.

J. R. Griffin succeeds **M. A. McCullough** as manager for the Rico Argentine company at Rico, Colorado.

E. H. Clausen, Captain in the Engineer Officers Reserve Corps, has been ordered to Camp Lee, for training.

H. R. Wagner has been appointed representative of the American Smelting & Refining Co. on the Pacific Coast.

H. R. Norsworthy has gone to take charge of the Grau chrome mine at Red Bluff, California, for **Samuel H. Dolbear.**

William B. McPhee, formerly research chemist at Timber Butte mill, Butte, Montana, is now mill superintendent for the Como Con. Mines Co., at Como, Nevada.

HELPING THE UNFORTUNATE

A friend sends us a statement of account from Perugia, in Italy, showing how much good was done with a 100 dollars, when exchanged into Italian currency, making 917 lire. We reproduce the statement thinking that at least one of our readers would like to do a similar $100 worth of kindness to the victims of warfare in beautiful Italy. Any subscription sent to the Editor will be forwarded and properly acknowledged.

Account of 917 Lire Received from H. R. to be Spent on Refugees and Wounded Soldiers

Perugia, March 1918.

		Lire
48	pillow-cases for hospital	117.00
18	sticks for crippled soldiers	34.00
22	pillows for wounded	132.00
9	pairs of good crutches	96.00
24	pairs of ordinary crutches	84.00
13	woolen shirts for wounded	125.00
36	pairs of special slippers for wounded feet	100.50
4	bed-rests	31.00
6	pairs of cotton socks	24.00
31	litres of marsala distributed to the weak and badly wounded	108.50
	Biscuits and oranges for badly wounded	15.00
	Money given to soldiers whose families had been left in invaded provinces	17.00
	Carriage for two afternoons to take four mutilated soldiers (two at a time) out for a drive, as they had not been out of the hospital for six months.	33.00
	Total	917.00

THE METAL MARKET



METAL PRICES

San Francisco, April 30

Aluminum-dust, large and small lots, cents per lb	65—70
Antimony (wholesale) cents per pound	13¼
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7¼— 8¼
Platinum, pure and with 10% iridium, per ounce	$108—$116
Quicksilver, per flask of 75 lb	$115
Spelter, cents per pound	9¼
Zinc-dust, cents per pound	17½

ORE PRICES

April 30

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38% and over, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton	$7.00—$8.00
Manganese, 40 to 50% Mn, Hazen, Nevada, cents per unit	92—110
Manganese, 48%, New York, per unit	$1.20
Tungsten, 60% WO_3, California, per unit	$24
Molybdenite, per lb., 85% MoS_2	$1.80
Pyrite, domestic, New York, per unit of sulphur, cents	28

EASTERN METAL MARKET

(By wire from New York)

April 30.—Copper is unaltered. Lead is inactive and easier. Spelter is quiet though steady. Platinum is not quoted.

SILVER

Below are given official or 'ticker' quotations, in cents per ounce of silver 999 fine. The actual figure at which the metal is bought and sold is a matter of negotiation, and is not available, but the prices given indicate such approximately. Premiums are paid, up to 3c. per oz. See 'M. & S. P.' of March 23, 1918, for full details. From now on the price of the metal is fixed at $1 per ounce.

Date	New York, cents	London, pence
Apr. 24	99.75	49.25
" 25	99.75	49.25
" 26	99.62	49.25
" 27	99.62	48.25
" 28 Sunday		
" 29	99.62	49.25
" 30	99.62	49.25

Average week ending	
Mch. 19	86.71
" 26	91.27
Apr. 2	92.12
" 9	91.74
" 16	93.73
" 23	97.35
" 30	99.66

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

On April 23 the Silver Bill was signed by the President, fixing the price at $1 per ounce.

Silver exported from San Francisco during March was valued at $9,951,351. Of this, $7,652,720 went to India, the remainder to China.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67c. for small lots, effective until June 1, 1918. Quotations in cents per pound are as under:

Date	
Apr. 24	23.50
" 25	23.50
" 26	23.50
" 27	23.50
" 28 Sunday	
" 29	23.50
" 30	23.50

Average week ending	
Mch. 19	23.50
" 26	23.50
Apr. 2	23.50
" 9	23.50
" 16	23.50
" 23	23.50
" 30	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36 00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	23.50	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Calumet & Hecla and subsidiary companies has increased wages from 5 to 25%, effective May 1. About 10,500 men will benefit.

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date	
Apr. 24	6.90
" 25	6.85
" 26	6.80
" 27	6.80
" 28 Sunday	
" 29	6.80
" 30	6.80

Average week ending	
Mch. 19	7.25
" 26	7.25
Apr. 2	7.19
" 9	7.13
" 16	7.00
" 23	6.95
" 30	6.83

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

A Government embargo has been placed on importations of lead in order to save freight space.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. In February 1918 the Government fixed prices for grade A spelter at 12c. per lb. for itself and the open market. This grade constitutes only a small proportion of the total output. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c. per pound.

Date	
Apr. 24	6.87
" 25	6.87
" 26	6.87
" 27	6.87
" 28 Sunday	
" 29	6.87
" 30	6.92

Average week ending	
Mch. 19	7.75
" 26	7.56
Apr. 2	7.33
" 9	7.23
" 16	7.00
" 23	7.00
" 30	6.88

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Cable advice from Australia states that the British government will purchase all zinc concentrate produced in the Commonwealth during the War and for 10 years after.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date	
Apr. 2	105.00
" 9	115.00
" 16	115.00
" 23	115.00
" 30	115.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115.00	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

The report that Holland had put an embargo on the export of tin from its East Indies is denied by that Government. What was done was the issuing of licenses, as is customary in England.

It is reported that considerable quantities of tin en route from San Francisco to the East have been 'lost,' and the Tin Committee of the New York Metal Exchange is investigating the matter.

Eastern Metal Market

New York, April 24.

Inactivity still pervades all the markets and there is little news of decided interest except in tin.

Copper market conditions are unchanged.

The tin market is at a deadlock, and almost no business is being transacted. Prices are soaring.

Lead is very quiet and a little easier.

Zinc continues to show weakness.

Antimony is unchanged.

In the iron and steel market the operating conditions are improving daily. The leading producer in the Pittsburgh district had 96% of its rated blast-furnace capacity active last week and 98% of its bessemer and open-hearth steel capacity. The Carnegie Steel Co. is now giving practically 100% of its rolled product to war requirements. Other Central Western plants are giving 75 to 90% of their shipments to the Government. The barb-wire needs of the Allies have swelled to 110,000 tons, of which 60,000 tons will go to Italy and 50,000 tons to France. Car scarcity is still acute, particularly in the South, where tens of thousands of tons of pig-iron, which buyers need, is accumulating at the furnaces. The large order for cars is still delayed and valuable time is being lost.

COPPER

The meeting of Government representatives and copper producers to confer as to the price of copper after June 1 is to be held earlier than expected. It is scheduled for May 1. There are quite a number who predict that the present price of 23.50c. will be advanced to 25c. per lb., while there are some who expect no change. The agitation for a higher price the last few weeks, based on increased costs of refining in particular, is believed to have had the effect of at least preventing a reduction in the present price. Sales are being made for delivery beqond June 1, and some before that, the price to be the Government's at that time, which is considered significant. There is no change in fundamental conditions. Production is proceeding at a high rate, and sales and distribution are apparently satisfactory under the control of the Copper Producers' Committee. Copper exports to March 1, 1918, have been 68,691 tons, of which France has taken 36,654 tons and the United Kingdom 21,318 tons, with 8939 tons going to Italy.

TIN

The conference in Washington last week, mentioned in our last letter, was of considerable importance. Representatives of the solder, babbitt, tin-plate, bronze, and all other tin users were present. The meeting had for its chief object the consideration of means to conserve the supply of tin for the Nation. It was stated that the estimated needs of the country for the year amounted to 90,000 tons, not including 12,000 tons for special heavy work, and that this total must be cut down to about 74,000 tons or practically 25%. The consumers were urged to conserve tin wherever possible by using low-grade metal in such mixtures as feasible, so as to save the high-grade tin for more vital uses. Because of a lack of offerings the tin market in general has come to a standstill. Very little business has been done. That which is reported has been mostly Chinese tin for April-May shipment from China at unheard-of prices, reaching up to 85c. per lb. There is scarcely any Straits or Banca tin offered. The only feature of improvement is the fact that licenses are being obtained a little better, though very slowly, in England for shipment of English tin to American consumers. Spot tin is quoted nominal at 88c., New York, but almost unobtainable. It is reported that one small lot brought $1.02 per lb. in the last few days. Arrivals to date have been 420 tons, with 5000 tons estimated afloat. Prices in London are very high again. Yesterday spot Straits was quoted at £343 10s. per ton, or £20 higher than a week ago.

LEAD

General conditions are practically unchanged since last week. There is still a little more lead offered than the market is ready to absorb, and as a consequence prices are slightly lower at 6.90c., New York, or 6.75c., St. Louis, for early delivery. Most large producers are well sold up for April-May shipment, and the plant of one large producer is still closed because of labor troubles. The offerings referred to come from small producers. There is very little activity, and the entire market is quiet. There is some inquiry for export.

ZINC

There is not much activity in zinc. If anything, the market is weaker, due almost entirely to underselling by some producers. With not much business actually transacted, and with various quotations being made, the actual levels are hard to quote. The quotation for early delivery and for May-June shipment is about 6.62½ to 6.75c., St. Louis, or 6.87½ to 7c., New York, at which prices some sales have been made for May-June. For July-August shipment about ⅛ to ¼c. higher is asked and has been obtained on some small sales. Reports for the first quarter, referred to briefly last week, show also a 4000-ton increase in stocks on hand March 31 as contrasted with December 31, 1917, that producers having 195,000 retorts had 112,000, or 57%, operating April 1. Production in the first quarter this year was 136,000, as contrasted with 183,150, 187,322, 161,668, and 153,296 tons, respectively, in the four quarters of 1917.

ANTIMONY

Demand is light and quotations are unchanged at 12.75 to 13c., New York, duty paid, for Chinese and Japanese grades.

ORES

Antimony.—The ore is available at $1.75 per unit, but there is only a very quiet market.

Ferro-manganese: An interesting new phase of this market is the Government proposal to make the standard domestic ferro-manganese a 70% alloy, instead of 80% as now, and to make the standard domestic spiegeleisen 16% manganese. No official announcement has been made, but one American maker is now quoting $250, delivered, for 70% ferro-manganese, with $4 per unit extra above or below this, and $70 at furnace for 16% spiegeleisen with $3.50 per unit extra for each unit above this. The Government's object in this is to encourage the use of low-grade domestic manganese ores.

The new Federal government order prohibiting all importations by sea of ferro-manganese means the cutting off of all British alloy. This amounts at present to almost 2000 tons per month. Its loss is not viewed with equanimity in the trade.

Molybdenum.—There is practically no market. The prohibition of all importations of molybdenum will not have much effect, as little has been coming by vessels.

Tungsten.—Quotations are unchanged at $20 to $24.50 per unit in 60% concentrates, depending on the grade, and a fairly active business is reported for the past week. Ferro-tungsten is quoted unchanged at $2.25 to $2.40 per lb. of contained tungsten.

Company Reports

MYSORE GOLD MINING CO.

Property: extensive property and treatment plants in the Kolar field of India.

Operating Officials: John Taylor & Sons, managers; R. H. P. Bullen, superintendent.

Financial Statement: during 1917, gold sold, etc., realized £803,731 ($3,900,000). All charges amounted to £399,435 ($1,920,000), leaving a profit of £404,296 ($1,930,000). The year started with a balance of £111,665 ($537,000) and ended with £83,044 ($398,000). The reserve fund is £150,000 ($720,000); cash and gold, £243,624 ($1,170,000); and stores, £132,817 ($638,000).

Dividends: £259,250 was paid last year, making £8,649,594 ($41,520,000) since 1886.

Development: exploration in 1917 exceeded that of 1916 by 1594 ft. The Edgar shaft is 3808 ft. deep and McTaggarts 3003 ft. Results were generally good. Reserves are estimated as 939,000 tons, a decrease of 80,000 tons.

Production: 307,126 tons of ore, 261,299 tons of tailing, and 262,156 tons of slime yielded gold worth £842,057 ($4,035,000). Total since 1884 is 5,138,250 tons of ore and 5,026,168 tons of tailing, yielding £18,739,343 ($90,230,000).

CERRO GORDO MINES CO.

Property: mine near Keeler, Inyo county, California.

Operating Officials: L. D. Gordon, general manager; J. C. Climo, superintendent; John Nelson, in charge of aerial tram; H. G. Rose, mine office.

Financial Statement: cash receipts during 1917 totaled $609,554, including $112,377 brought forward from 1916. Operations cost $214,055. Deducting cost of new property, Liberty Bonds, and dividends, cash carried forward for 1918 was $79,699.

Dividends: four absorbed $225,000.

Development: this amounted to 4993 ft. The main source of ore was the deposit south of the shaft. Between the 700 and 900-ft. levels the shoot was cut off by a fault, but its extension is being sought. The 400 and 700-ft. levels are now supplying ore shipped. The Spear mine adjoining the Cerro Gordo is being explored under option. It has promising indications.

Production: this consisted of the following:

Product	Tons	Lead, %	Silver, oz.	Gold, oz.	Zinc, %
Lead ore	6,088	30.27	18.73	0.02	....
Zinc ore	5,417	....	....	....	31.14
Old slag	14,034	11.17	3.32	....	....

The metal contents were therefore 3,686,387 lb. lead, 3,373,548 lb. zinc, 128,075 oz. silver, and 123 oz. gold.

Costs: these totaled $15.03 per ton of ore mined, which averaged $35.02 per ton.

JUDGE MINING & SMELTING CO.

Property: mine and works at Park City, Utah.

Operating Officials: G. W. Lambourne, general manager; O. N. Friendly, general superintendent.

Financial Statement: sales of ore returned, $953,729. With sundries, receipts for 1917 were $992,864. All expenses totaled $934,314, including $357,957 for the new zinc plant. Balance forward from 1916 was $555,290, and that to 1918 is $133,840.

Dividends: four absorbed $480,000. This makes $2,070,000 to date.

Development: from the 500 to 1900-ft. level, on three vein systems, exploration advanced 7482 ft. An unknown ore-zone was proved, by prospecting after a study of geologic conditions. One of the largest bodies of shipping ore was thus discovered.

Production: the 380-ton mill dressed 63,387 tons of ore, producing 11,861 tons of lead and 5526 tons of zinc concentrates. Crude ore sold was 7247 tons. Metal contents were as under:

Product	Lead, %	Copper, %	Zinc, %	Silver, oz.	Gold, oz.
Crude ore sold	14.26	1.10	10.03	35.18	0.023
Lead concentrate	24.59	1.03	10.09	26.62	0.029
Zinc concentrate	4.30	1.30	43.11	19.86	0.020

The yield in 1917 was 7,919,720 lb. lead, 428,000 lb. copper, 585,680 oz. silver, and 532 oz. gold.

Owing to lack of essential chemicals for the electrolytic zinc works, no spelter was sold. A shipment was made in March 1918.

AMERICAN SMELTING & REFINING CO.

Property: mines, smelters, and refineries in the United States, Mexico, and South America.

Operating Officials: general managers—C. W. Whitley, in Utah; L. G. Eakins, in Colorado; C. L. Baker, in Mexico; R. T. White, in Chile; Kuno Doerr, South-Western department; H. A. Guess, managing director of mining department; W. M. Drury, manager of mining in Mexico; E. A. Behr, lead sales agent; and H. M. Brush, assistant manager of copper sales.

Financial Statement: revenue and expenditure may be summarized as under:

Metal sales and manufactures	$428,401,471
Mining properties, etc	15,578,830
Balance and loans at January 1, 1917	19,941,492
Total income	$463,921,793
Paid for ore, bullion, expenses, and taxes	426,017,668
Property expenditure	6,586,274
Advances, acceptances, A. S. S. Co. bonds purchased, interest, etc	4,014,356
Dividends paid	8,982,525
Total charges	$445,600,825
Balance, loans, and Liberty Bonds ($6,419,250) at December 31, 1917	18,320,968
Total	$463,921,793

The profit aggregated $25,035,938, which is $206,359 less than that in 1916. Corporate taxes were $2,864,005 greater. Deducting depreciation and depletion of ore-reserves, appropriation for insurance and pensions, and sundry charges, the net profit was $18,495,625.

Dividends: preferred stock received $4,712,666, equal to 7%; and common stock, $4,269,860, or 6%, plus 1% extra Red Cross distribution.

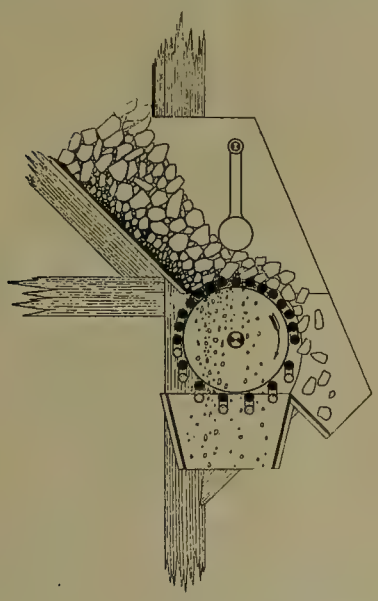
General: metal production of the company will be published in another issue of this journal. All supplies are costing from 50 to 150% more than normal. Labor has been short and demanded increased wages. The company is suffering from an entire lack of economic law, as the Government is fixing the value of such metals as the company produces. The Mexican situation, regarding the A. S. & R. properties, is only fair. Plant expenditures totaled $6,605,691, of which $4,700,000 was spent at Garfield, El Paso, Hayden, Baltimore, Perth Amboy, and Tacoma. The smelting and refining capacity of the company is now 1,500,000,000 lb. per annum, the present output being 1,000,000,000 lb. Metal stocks are valued at $36,339,500, a gain of $8,861,849. Large expenditures were made for safety devices. Plant inspectors are subjected to more rigid rules. Accidents decreased 25% during 1917. Safety and hospital charges, etc., totaled $340,000; plus $100,000 for erection of club-rooms and community houses. The company is insuring 6062 employees for policies totaling $5,037,500. Pensions were granted to 34 beneficiaries in 1917, making 232 in all.

INDUSTRIAL PROGRESS

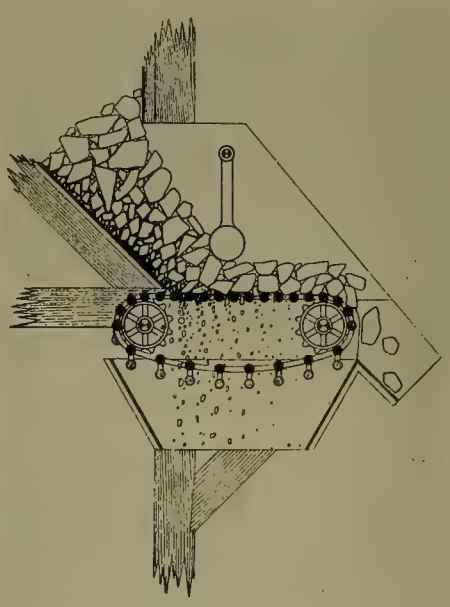
INFORMATION FURNISHED BY MANUFACTURERS

ROSS AUTOMATIC DROP-BAR GRIZZLEY-FEEDERS

The difficulties of feeding and screening coarse ore are well known to mine and mill operators. Probably at no other point in a plant are the sledge-hammer and the repair gang so much in evidence. It seems strange that so simple an operation as feeding and screening should give trouble, until one examines closely the usual cause of the mischief, that is, the strangely shaped 'neutral' pieces, which will neither pass through the grizzley nor be carried over. This source of trouble has been completely eliminated in the Ross automatic drop-bar grizzley-feeders, designed by William Ross, who, as mechanical engineer on mines in South Africa and America, has for years been a participant in many sledge-hammer episodes. In addition, these machines have overcome other well-known difficulties, such as the blocking of large ore at the bin-opening, and irregular rushes of ore in the chute with the consequent inefficiency of the grizzley itself and of the machine being fed. The device is covered by patents.



Ross Rotary Drop-Bar Grizzley-Feeder.



Traveling Type of Drop-Bar Grizzley.

The accompanying illustrations show the Ross rotary and traveling types of machine, consisting essentially of an apron of equally spaced bars, which are fed slowly forward under the lip of the bin-opening. The quantity of ore drawn away is determined by the speed of the moving bars and the relative position of the heavy flexible door. The main bin-opening is made quite large, and when a big piece comes through the gate it will swing outward temporarily to allow it to pass, returning afterward to its normal position. On reaching the discharge point, each alternate grizzley-bar drops, remaining clear during the return half of the cycle, at the end of which it automatically comes into position, ready again for the operation of screening and feeding. All trapped pieces are thus released and discharged without delay. On their return trip to the starting point, the bars do not obstruct the free passage of the fine ore. No internal chutes for fine are necessary, and consequently the head-room required is small; the traveling type of machine can even be run up at an angle necessitating no allowance for height between the bin opening and the crusher. The rotary machine consists of two heavy cheek-plates keyed to a protected steel shaft carried by two bearings. The main grizzley-bars are socketed in the flanges of the cheek-plates and the secondary grizzley-bars are linked to the main bars, and supported at the ends during the screening operation by an inner shoulder on the cheek-plates. Arrangements are provided so that the grizzley-space can readily be adjusted within a wide range. The bars can be removed individually. In the traveling type of machine, the flanges of the rotary type are replaced by chains with hardened pins, on which the grizzley-bars are socketed. For heavier service the chains are of the roller type and track-rails are provided. In all cases the machines are designed for continuous running without attention.

Over a dozen machines are already installed with screen spaces from ½ in. to 3 in., and negotiations are being completed for the installation of heavier machines, notably one with 8-in. screen-spaces. This machine will handle large run-of-mine ore, at the rate of 350 tons per hour when the bars are moving at a speed of 30 ft. per minute. The bars

are 5 in. diam. and the figures show that 25 sq. ft. of grizzley surface will be presented to each ton of ore. The mining world has responded promptly to the unique advantages offered by these machines, and manufacturing facilities are in working order to meet the demand.

Further particulars can be obtained from the Ross Engineering Co., 908 Eastern Townships Bank Bdg., Montreal, Canada.

THE MEYER DRY ORE CONCENTRATOR

In presenting the Meyer dry ore concentrator to the mining world it is with the realization that it is still far from being perfect, but with the conviction that the principle upon which the process is based is absolutely sound, and with the knowledge that there is a positive demand and a real need for a concentrator of this class. While in a class by itself in arid districts and high localities, this concentrator will quickly prove its merit wherever it may be used, and in placing it upon the market it is with the fullest confidence of meeting the approval of every progressive miner and of the mining engineering and metallurgical professions.

The Meyer dry ore concentrator, even on the most difficult



GENERAL VIEW OF MEYER CONCENTRATOR

of complex sulphide ores, and oxide and carbonate ores, as copper carbonates, has never averaged less than 85% of the total content of the ore. The Meyer concentrator is constructed entirely of steel, the frame of heavy channel and angle iron, and the cylinders of heavy-gauge sheet steel. It will last a life-time with practically little or no repair. It uses any kind of power and therefore can be operated anywhere that mining can be successfully conducted. It operates entirely dry, requiring no water whatever, and it can be quickly erected by any ordinary handy man. It requires no skilled labor to operate it. Every section is a complete concentrator in itself, generally termed a 'cylinder', being the exact duplicate of every other section. Each section will have a capacity of from three to six tons per 24-hour day depending upon the ore and the amount of rock to be eliminated; as many sections being ordered as capacity is desired. Additional sections may be added as the tonnage increases without stopping or interfering with the sections already operating.

The Meyer dry ore concentrator is a series of inclined revolving hollow cylinders, made of heavy-gauge sheet steel, and connected by an air-tight compartment with an ordinary exhaust fan. Each complete section, or cylinder, is a complete concentrator in itself, entirely separate from the other sections, having its own individual driving mechanism, feed, exhaust-fan, and its own individual regulating valves. Each section occupies approximately two feet of floor space in width, while the length is exactly nine feet. The width of the various sections being only determined by the closeness of placing the exhaust fans. This concentrator is designed so that each separate section, or cylinder, is receiving the ore of only one size. In the case of an ore classifying into 20 sizes, for example, a very convenient installation would be 20 sections, thus permitting all of the 20 different sizes being fed through the concentrator at the same time, each into a separate and independent section.

The Meyer system is dustless. Although the ore will be crushed in a dry state, by connecting up an ordinary exhaust fan, or one section of this concentrator, specially designed for this purpose, the suction of the fan can be regulated not only to remove all the dust, but also as many of the fine sizes as desired. In case the dust and fine contain sufficient mineral to warrant saving and treating, the air-current containing the dust and fine can be led into a larger room where they will be precipitated in direct proportion of the size of the pipe through which the dust is led into the room. The Meyer concentrator requires about one-half horse-power to operate the exhaust fan at the necessary speed, and to revolve the cylinders less than a quarter of a horse-power. In other words it requires less than one horse-power per cylinder. The capacity primarily depends upon the amount of rock to be eliminated. The suction of any cylinder is only able to suck up the amount of rock that that particular section is capable of removing. The capacity is conservatively stated to be from three to five tons of ore per day, but where the amount of rock to be removed is not so large, the capacity will be much greater. This concentrator is made by The National Milling & Refining Co. at Canton, Ohio.

CREOSOTE AS A WAR-TIME PRODUCT

The demands of the War have seriously affected the labor situation on the railroads. The high wages of the munition plants have attracted the men from the section gangs of the railroads and many of the laborers have entered the military forces of our country. These vacancies have not been filled in many cases and consequently the maintenance-of-way work is being done by a decreased number of workers. As an illustration of the decrease of labor, one of the divisions of a large Eastern railroad employed 544 men in section gangs in December 1912, and in December 1917 the personnel of these gangs totaled 358. Having a lessened number of employees with which to do the same amount of work as previously, the supervisors were confronted with the problem of eliminating some of the work and of getting greater results from the labor expended. One of the chief duties of the gang is to replace defective ties that have rotted through exposure and wear. This changing of ties requires a large portion of the time spent in repairing the road bed and consequently any saving in this work would decrease the amount of labor required to a considerable extent. The average length of life of a tie is about eight years, and with the enormous number of ties used on the railroads of America, this means an enormous number of replacements each year especially when one considers that there are over 2,310,000 miles of track operated by American railroads, and that the ties required in this stretch of steel amount to over 577,000,000. This means that there are over 90,000,000 ties replaced every year, and as the changing of each tie requires an hour's work a large amount of time is thus consumed.

The possibility of saving a large part of this time has caused the supervisors of railroads to order all ties creosoted before being placed in service. Creosoting doubles the life of the tie and proves a resistant against the ravages of climatic conditions and other forms of decay. The creo-

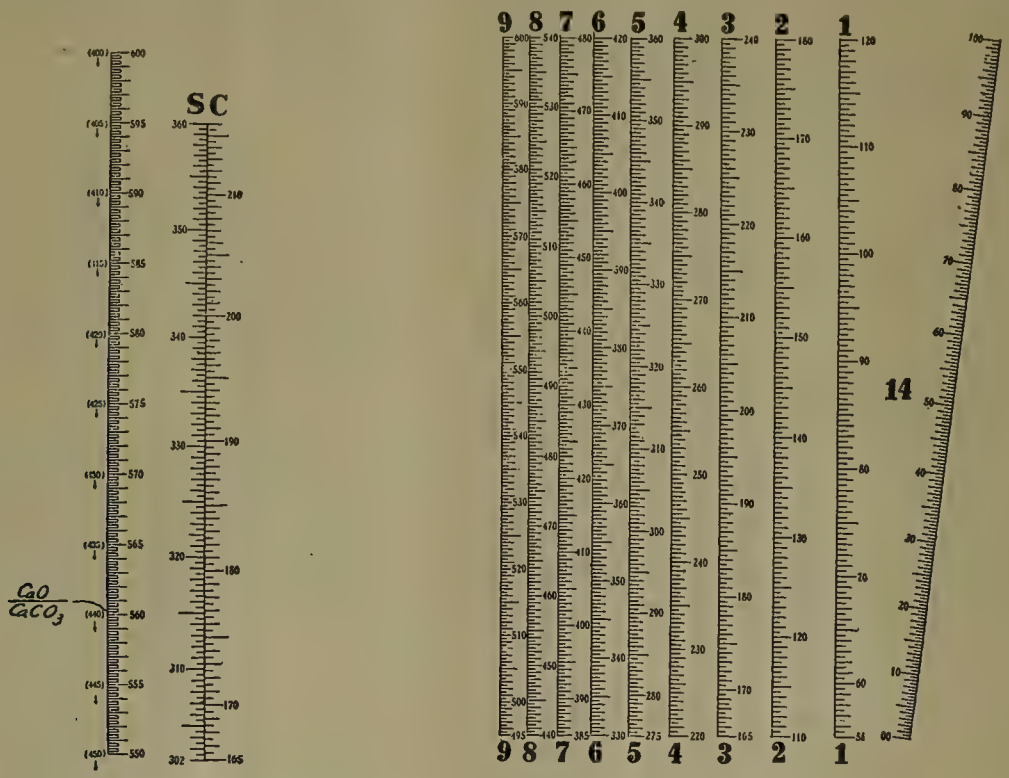
soting process consists of heating the tie to drive off the moisture and then immersing it in a bath of hot creosote. The creosote is absorbed into the cracks of the wood and when taken out of the bath, the tie presents a water-proof surface that will last for many years. The manufacturers of creosote in this country have perfected their product to suit the need of the railroads and as a result most of the large companies have made the use of creosoted ties standard, thereby saving thousands of hours of labor yearly.

THE NOMON—A CALCULATING DEVICE FOR CHEMISTS

By Horace G. Deming

The slide-rule has never been in such general use among chemists as among engineers, doubtless for the reason that many of the calculations of chemistry demand a higher degree of accuracy than that obtainable with the ordinary form of this instrument. There seems to be a demand for an instrument at once more accurate than a slide-rule, and cheaper, handier, and more portable than a calculating machine. A calculating chart designed by myself, and published by the University Press, Urbana, Illinois, to which the name 'nomon,' that is, nomographic reckoner, has been given, seems to satisfy these requirements. It will multiply, divide, square, cube, and extract square roots and cube roots, giving results to four figures, with an average error of about one unit in the fourth place, a degree of precision about 5 or 10 times that of an ordinary 10-in. rule. For solving proportions it is not so convenient as a slide-rule, but one should remember that in an ordinary chemical proportion two of the terms can usually be combined in a single constant, thus reducing the calculation to a simple multiplication or division. In the construction of the nomon the logarithmic principle at the basis of the slide-rule has been abandoned entirely, and resort is had to a new combination of graphical principles. The present paper is intended merely to indicate the method of using the chart, and the special advantages that it offers in chemical calculations.

To multiply two numbers together, find one of them, neglecting decimal points, on the scale at the left of the chart, called the principal scale. Find the other number, after dropping its first figure, on the inclined scale at the right. Connect the two points thus located by means of a straight line scratched on the under surface of a strip of celluloid that accompanies the chart. The product is read from the intermediate scale that is labelled above and below with the figure of the multiplier that has been dropped. Thus the product of 586.8 and 0.7419 is found by locating the first of these numbers on the principal scale, and 41.9 on the inclined scale. If the hair-line of the transparent strip is placed to connect these two points, it will intersect the scale numbered 7 (the figure dropped from the multiplier) in the point 435.3, which is the required product. The decimal point is best located by inspection, though there is a rule for fixing its position mechanically, if desired.



Fourteenth Section of Nomon, Reduced from 7 Inch by 10½ Inch.

Division may be performed by a process the converse of that just described for multiplication. Reciprocals may be read directly from the chart, to four, or even five figures. Auxiliary scales, placed just to the right of the principal scale, permit squares and cubes to be read directly, when points on the principal scale are connected with the point 00 of the inclined scale. Square roots and cube roots may be obtained by a converse process. Though the chart gives results directly to but four figures, its use may be combined with the ordinary methods of calculation, in such a way as to give verified products, quotients, or roots to six or seven figures, in a small fraction of the time otherwise needed. In order to attain the degree of precision just mentioned, it has been found necessary to subdivide the principal scale, and therefore the entire chart, into eighteen sections. Thus the fourteenth section, reproduced in the figure, covers the

range of multiplicands from 550 to 600. A marginal index provides for instantaneous reference from one section to another. About three-fourths of the labor of disconnected multiplications and divisions falls on the last four sections.

All the scales of the chart were originally laid off on metal with a dividing engine, and all the calculations and methods of construction used in its design have been verified mechanically. In order to secure maximum legibility, special attention has been given to the method of subdividing the unit interval of each scale. In this respect the chart offers distinct advantages over the slide-rule, in which unit intervals subdivided into fifths are frequently confused by beginners with those subdivided into tenths. In most of the sections three digits of each result are given in plain figures—an additional safeguard against errors. The chart may be rolled up and carried in the pocket, and in spite of its increased precision is much less expensive than a slide-rule, the present edition selling for a dollar. Perhaps the most important advantage of the nomon is, however, to be found in the fact that it may be adapted very readily to individual requirements, by inscribing special factors along the margins of the chart, beside corresponding points of the principal or inclined scales. It is thought best to leave the location of such points to the individual user, in order that the chart may not be encumbered with data of little use to him personally. Thus points representing the common gravimetric and volumetric chemical factors, inscribed along the principal scale, may be used as constant multipliers. (The factor $CaO/CaCO_3 = 0.5603$ is indicated in the figure). A hole near one end of the transparent strip is set over a given factor and held in place with the rubber tip of a pencil, cut to a conical point. If the free end of the strip is now swung over the face of the chart, to pass through each of a series of weights or buret readings in turn, products or quotients may be read off almost as fast as an assistant can note them down. With the ordinary type of slide-rule, about half of the results of such a series of operations will lie beyond the limits of the scales, making necessary frequent re-settings, if the operations are carried out in order. Or the section concerned, printed separately on bristol-board, may be fastened to the wall or table-top, and the transparent index set permanently over the given factor by means of a thumb-tack.

DIXON'S GRAPHITE PRODUCTS IN MINING

When a quick, convenient, and positive cure for slipping is desired there is nothing better than 'solid belt dressing.' Traction-belt dressing is for use when there is time and opportunity for applying a paste dressing. It penetrates the fibre of the leather, strengthening it and bringing back vitality. If there is anything that will waterproof a belt, preserving it against the spatter of water, wet steam, and destructive chemical action, it is Dixon's traction-belt dressing.

Dixon's 'solid belt-dressing' should be used as a convenient dressing for leather, rubber, and fabric belts. The 'waterproof graphite grease' may be employed for the lubrication of cables, the use of which is extensive in mining. During the operation of re-making the cables they may be lubricated also. Probably most companies have what is known as a rope-house where this operation is performed. After all of the strands are taken out and thoroughly cleaned and wound on separate drums, they are then re-woven, and as the re-finished rope comes forth foot by foot, it is passed through an iron trough or 'mulligan', as it is termed. This 'mulligan' has a false bottom to which is conducted live steam. The grease is placed in this and heated to a degree sufficient to melt it. Then the rope is passed through this solution. By following this operation, a thorough coating of lubricant is applied to all of the strands. Another important use for 'waterproof grease' is on dredges. The endless chain of bucket type, with upper and lower tumbler bearings, requires a special method of lubrication to which Dixon's 'waterproof graphite grease' is peculiarly adapted. The uses for Dixon's 'silica-graphite paint' in this field are numerous. The chief of these is for smoke-stacks and other metal work subject to corrosion by acids, alkalies, gases, and the weather. Numbers of mining companies have used the 'silica-graphite paint' for these purposes and have had excellent satisfaction. Explanation of the various products and their particular application to mining will be given on request to the Dixon company.

DU PONT PRIZE PHOTOGRAPH CONTEST

To increase the interest in the Du Pont products, and to secure suitable photographs to illustrate the advertising and publicity of their various companies the Du Pont American Industries offer $500 in prizes for the 50 best photographs. The prizes are as follows:

First price, $100; second prize, $50; third prizes, two of $25; fourth prizes, fourteen of $10; and fifth prizes, thirty-two of $5.

The photographs are to illustrate the following subjects, and be submitted before September 1, 1918: Agricultural uses of explosives; fabrikoid (artificial leather); industrial uses of explosives; painting; trapshooting and hunting; miscellaneous. Any subjects illustrating the use of any Du Pont products, will be given equal consideration. Some of the conditions of the contest are: No employees of the Du Pont American Industries are eligible; each photograph, to be eligible for a prize, must be accompanied by the negative (film or plate); on the back of each photograph submitted must be plainly written the name and address of the contestant, the subject illustrated, the place where the photograph was taken, and any other helpful data; the number of photographs that can be submitted by any one contestant is unlimited, nor is there any limit to the number of prizes that can be won by any contestant; all photographs submitted, whether awarded prizes or not, are to become the property of the Du Pont American Industries; all photographs submitted will be judged by a committee to be appointed by the director of advertising of the Du Pont American Industries, the prizes to be awarded not later than September 15, 1918; the Du Pont photograph contest will close on September 1, 1918; no photographs postmarked at Wilmington, Delaware, later than September 1, 1918, will be accepted in this contest; each contestant must fill out and mail an entry blank to the advertising division of the Du Pont company, Wilmington, Delaware, with the first photographs submitted, or the photographs will not be accepted in the contest; all photographs entered in this contest must be plainly marked 'Photograph Contest' and mailed to the Advertising Division of the Du Pont company, Wilmington, Delaware, full postage prepaid.

The Du Pont products are used or sold in almost every business house and home in this country. Probably in your own home, or in the neighborhood, or at least where you work, there is a good chance to obtain a prize-winning photograph. To the amateur, it may be said that he should see that his photograph has good contrast, and is clear and sharp in focus. If possible, it should be at least 3 by 5 inches in size. Experience prompts the suggestion when the photograph is taken, make a black and white, glossy finish print. Do not try too hard to get an unusual effect. This is not an art contest. These photographs are to be used for advertising purposes, and if they show clearly and effectively what they are supposed to represent, and will reproduce well, they will have a good chance of winning a prize. Any one desiring to enter should notify the Du Pont company, and an entry blank will be furnished.

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Science has no enemy save the ignorant

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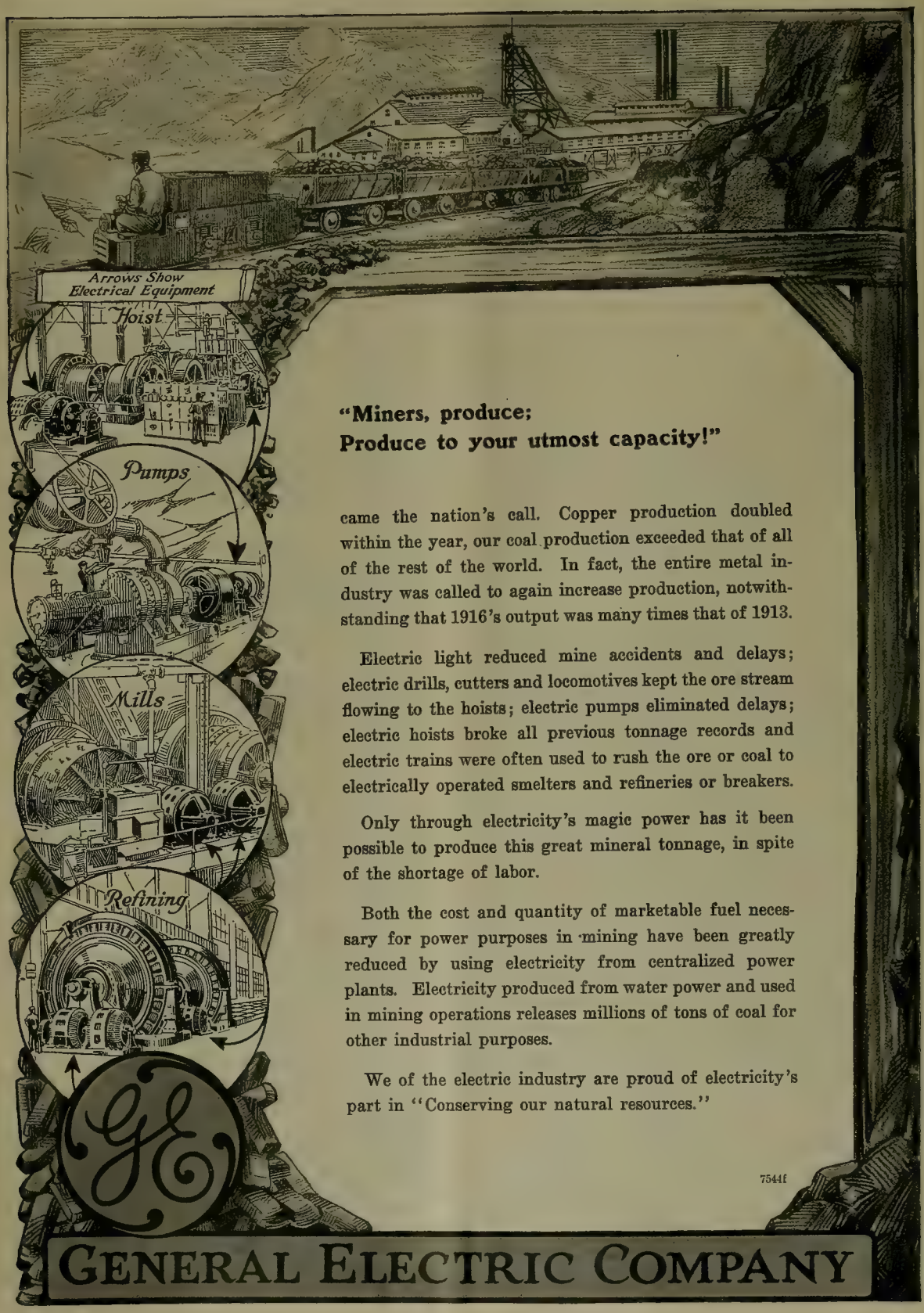
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**"Miners, produce;
Produce to your utmost capacity!"**

came the nation's call. Copper production doubled within the year, our coal production exceeded that of all of the rest of the world. In fact, the entire metal industry was called to again increase production, notwithstanding that 1916's output was many times that of 1913.

Electric light reduced mine accidents and delays; electric drills, cutters and locomotives kept the ore stream flowing to the hoists; electric pumps eliminated delays; electric hoists broke all previous tonnage records and electric trains were often used to rush the ore or coal to electrically operated smelters and refineries or breakers.

Only through electricity's magic power has it been possible to produce this great mineral tonnage, in spite of the shortage of labor.

Both the cost and quantity of marketable fuel necessary for power purposes in mining have been greatly reduced by using electricity from centralized power plants. Electricity produced from water power and used in mining operations releases millions of tons of coal for other industrial purposes.

We of the electric industry are proud of electricity's part in "Conserving our natural resources."

7544f

GENERAL ELECTRIC COMPANY



HURRAH for the Third Liberty Loan! Not only has it been handsomely over-subscribed, but the number of citizens contributing is 17,000,000, as against 10,000,000 to the second and 4,500,000 to the first loan.

IN an evening newspaper we read that "a hopeful sign in connection with local golf is the large number of young athletes of both sexes who are now playing the game." We differ: the male athletes that are young and that are devoting themselves to golf at this time are *not* "playing the game." They are slackers that are renegades to the true spirit of sport and a disgrace to the royal and ancient game of golf.

DURING the eight months preceding March the export of copper was 665,000,000 pounds valued at $196,000,000, as compared with 592,000,000 pounds worth $162,000,000 in the corresponding period of the previous year. On the other hand, the imports of copper in the same eight months amounted to 242,000,000, as against 212,000,000 last year and 167,000,000 the year before. Most of this came from Chile and Peru, the Mexican shipments having decreased, while those from Spain have ceased entirely.

IMPORTATION of lead has been restricted by the Government in order to save tonnage, both by land and sea. Even Mexican and Canadian shipments are under embargo, owing to railroad congestion, but it is expected that Mexican lead will be admitted again shortly for the sake of its silver contents. In the first eight months of the present fiscal year 114,000,000 pounds of lead has been imported, as against 41,000,000 and 64,000,000 in the corresponding period of the two preceding years. During the eight months 97,000,000 pounds came from Mexico alone, leaving only 17,000,000 to be credited to all other foreign sources of supply.

CESSATION of imports of tin from the Dutch East Indies has caused the price of that metal to rise in this country. We produce no tin, our supply coming largely from the islands of Banka and Billiton, belonging to Holland, and from Bolivia. The seizure of Dutch vessels is the immediate cause of our shortage of tin, but it is probable that our loss in one direction will be corrected in the opposite direction, for Great Britain, it is to be presumed, will arrange for the release of some of her supply, which comes from Cornwall, Nigeria, Australia, South Africa, and the Malay States. A large part of the Bolivian output has been coming to this country since the American Smelting & Refining Company built a smelter in New Jersey, but lack of shipping hinders importation at this time. Incidentally we may mention one of the substitutions incited by the exigencies of the War. The packing of jam for the British army is done no longer in tin-plate, that is, 'canned'; it is placed in a container made of cardboard, of which 3,000,000 are used weekly in the manufacture of jam.

NEWSPAPER control is a powerful weapon in a democracy. It is one easy to abuse. Mr. Hearst has acquired the Chicago 'Herald,' thereby widening the streak of yellow journalism that besmirches this country. It is a great pity—to put it mildly—that a man of such character should, by the control of a dozen newspapers, exercise so great an influence, for, unfortunately the printed word is taken seriously, particularly by the uneducated. A similar condition exists in England. Lord Northcliffe is a man of more principle than Hearst, of course, but he also has abused the power gained by his control of 'The Times' and a number of other newspapers. If the world is to be made safe for democracy, it must recognize the danger of unscrupulous newspaper-ownership. That might be done by restricting ownership to one paper.

NO longer need we speak of 'they'; it is 'we' that are fighting; not 'the' Allies but 'our' Allies are withstanding the German onslaught; it is 'our' line that is being held by the British, French, Belgian, and American armies, just as surely as if it were upon American soil, on the slopes of the Alleghanies or on the plains of Nebraska. Moreover 'our boys,' under the star-spangled banner, are in the thick of it, holding up their end in just the way we expected. After weeks of newspaper exaggeration of minor trench-raids and patrol-skirmishes it is good to read of real battles in which American soldiers have won the admiration of the French and British by their valor and skill. They showed "the greatest audacity and a fine spirit of sacrifice," said a French general, when conferring decorations on 117 men of the 104th (Massachusetts) regiment, which bore the brunt of the German attack in the forest of Apremont

on April 12. Mr. Lloyd George also has said, enthusiastically, that "the American troops are first-class fighting material, full of courage and resource, and very keen." Of course they are. We are proud of them.

AS a side-light on the enactment of the Pittman silver bill we print on another page an excerpt from the Congressional Record giving part of the debate in the House. We may dismiss the notion that it was passed as a measure of relief for the silver miners. Neither Senator Pittman nor any of his colleagues labored under a misapprehension regarding that. It was an urgent case of war legislation, put upon the statute books by request of the President, following the earnest solicitation of Great Britain to avert trouble in India. The German is not absent even there; his insinuations reach the ears of local potentates, and arouse dormant hatreds and suspicions. Large trade balances remained unsettled; the coin to satisfy them had not come forward, and the thought that the Indian was being used and cheated, subtly put into the Oriental brain, would be like setting fire to tow. It is easy to release this store of silver, now serving a minor financial purpose, which is measured by the relatively small sum of approximately $3.50 per capita, and convert the certificates it represents into a revolving fund for buying more metal from the miners. It is firing silver ammunition to destroy the German propaganda in America, which reminds one of the old Scotch superstition that the silver bullet never misses the mark. Incidentally it contributes to the welfare of Utah, Nevada, and a few other States in the Union. The market quotations on silver still show a considerable discrepancy, in spite of the fact that the Pittman bill became law by signature of the President on April 23. These represent prices fixed for business in London, and have nothing to do with the price actually obtainable in this country. On the other hand, the time consumed in securing settlement from the United States mints is such that many producers are willing to discount the fixed Government valuation in order to convert their bullion into ready cash. Certificates of reputable refiners, therefore, are negotiated through the banks, at a slight reduction from the standard dollar rate per ounce.

GOLD, its production and its economic status, is the subject of an article by Mr. Hennen Jennings appearing in this issue. Anything that Mr. Jennings writes is interesting because he is known to be an observant and sagacious engineer, with an experience enriched by travel and study in many countries. In his article he reviews the functions performed by gold in the business of the world, he gives a summary of the latest statistical information concerning output, he furnishes data on the increasing cost of production, and then discusses the gold standard in relation to the debts being incurred by the principal belligerent countries, thus affording the reader a valuable résumé of basic conditions. The comparative newness of big mining operations for gold is a good point, as illustrating the stimulating effect of modern science when applied to an ancient art. The Allies today produce 91.3% of the world's gold, whereas the output from the Enemy countries constitutes only 0.6%. This surely should prove a potent factor in the adjustment of international obligations when the War is ended. The estimate of the world's production for 1917 given by Mr. Jennings is $430,000,000, as against $414,000,000, the figures of our guess as given last week, and it will be noted that Mr. Jennings' forecasts of future production in Australasia, Canada, and Rhodesia, for example, are more cheerful than our own, because, we presume, our distinguished friend is averse from being too positive in matters concerning which full information is unavailable. One small point to which we demur is the statement that the first stamp-mill on the Mother Lode of California was started in 1852, for we happen to know that the first machine of this kind was a sectional 10-stamp mill brought by James Rickard, a Cornish mine-captain, to Coulterville on the Mariposa grant in 1850, to test a group of gold mines placed under option to John Taylor & Sons by General John C. Fremont. To say this is like taking coke to Connellsville, for Mr. Jennings is now honorably connected with mining on this same Mariposa grant. Turning to a more important matter, we note the striking simile used by Mr. Jennings in his closing paragraphs, in which he brings out the fact that gold is a storage-cell of human energy, that its value is founded upon the labor, mental and manual, expended in extracting it from the ground. We also like his view that the rich are merely the deflectors of such energy. When they die they leave it behind to be used by their successors. Therefore, in an intelligent community it should be the aim to deflect this energy to the most fruitful purpose.

Spoiling the War Minerals Bill

Announcement is made of the passage of the mineral-control bill by the House in a materially altered form. The fundamental reason for this measure, regardless of the wider ambition of some of its sponsors, was to provide assurance of mineral supplies that for the most part are needed in relatively small quantities, but are vital, nevertheless, for the successful prosecution of the War. By the action of the House of Representatives much of the stimulative value of the bill apparently has been eliminated. The Executive is shorn of authority to fix prices, and the fund available for subventioning approved enterprises is reduced to $10,000,000, being one-fifth of the amount originally proposed. Even the larger sum seemed to us inadequate for carrying out the purpose of the measure in the most useful way, but we supposed it would be comparatively easy to obtain further appropriations as the need was shown. To reduce the available funds to $10,000,000 and at the same time to withdraw the power of the President's administrative appointee to fix prices is to destroy the possibility of individual initiative in many hundreds of cases where men of limited means are willing to risk their savings in small mines that men of big business could not afford to operate. The

production of tungsten, chrome, molybdenum, antimony, and manganese, for example, does not constitute the class of enterprise that commonly attracts large capital. The Government will be short of its requirements in these substances unless the small miner is directly aided and protected in the manner proposed in the bill as originally introduced. The mining of pyrite in this country has been retarded in the past because the Spanish mines, capable of being operated on a large scale and at low cost in a country where small wages prevail, and containing copper and a minor amount of the precious metals to be won from the cinder as a by-product, offered an almost overwhelming competition against the exploiters of Eastern deposits where the ore was free enough from arsenic to make good sulphuric acid. These deposits must be protected by guarantees for a period at a fixed price, or must be financed by the Government itself, to warrant the use of the capital needed for development and beneficiation. Estimates by those best informed indicate a requirement of 9,000,000 tons of sulphuric acid this year, whereas there is sulphur available for making only 7,500,000, leaving a shortage of 1,500,000. In spite of a curtailment of the chrome ore set aside for refractories to about 12,000 tons, and of a reduction of the amount of chrome for use in the chemical industries from 40,000 to 20,000 tons, the urgent requirements for producing ferro-chrome swell the demand this year to about 150,000 tons, according to a forecast by the War Industries Board. Domestic production last year was only 40,000 tons, and without suitable guarantees it is not to be expected that small investors will be able to risk their money in the production of a mineral that exists habitually in small, erratic, and widely scattered deposits. It is just because most of the products specified in this bill are found in small quantities, and constitute a basis for mining that is highly speculative as compared with copper, lead, and zinc, for example, that this market has been dominated to a large extent by brokers. The producer usually has not been able to deal with the actual consumer. The middleman seemed necessitated, and, as usual in such cases, the field of the legitimate commission merchant has been invaded to a large extent by sharpers. Producers of the minor metals and minerals have been so victimized by disreputable brokers that the Government must extinguish the breed if a great increase of production in these substances is to be realized. That means direct contract with the miners, and facilities for assisting in financing operations of merit. It must be noted that a considerable proportion of the middlemen who deal in these subsidiary products are Germans and German sympathizers. A persistent policy on their part has been to keep negotiations with prospective producers dangling as long as possible, and to offer attractive prices so limited by conditions of time and other details imperiling the shipper as to check the output during the War and to cause financial losses that would discourage vigorous development. Congress is doing its best to facilitate the efforts of our country to grapple successfully with the grave issues raised by the War, and it has doubtless acted in the light of what seemed intelligent advice in emasculating the bill, as now reported by the Associated Press, but the result would be to leave these special industries exposed to the sinister influences that have dominated them in the past. We have but to recall how the Nation was tricked by the German chemists into wasting our precious opportunities to become independent of foreign resources in the matter of fixed nitrogen, to realize the importance of defeating the apparent purpose to limit the production of the vitally needed materials of War that this bill was intended to facilitate. We look to the Senate to re-instate the authority to fix prices and to make contracts for a period of at least two years on a basis commensurate with profitable operation, when the bill comes before it for consideration. We understand that the President, as well as the Secretaries of War and the Navy, already possess the right to commandeer these or any other minerals, but the prices are arranged by the War Industries Board through agreement with the producers. In this way prices may be established by the President, but only on the recommendation of the price-fixing committee, after an investigation has been made by the Federal Trade Commission. This is a long circuitous method of approximating the end that is attainable directly and swiftly by a single administrator under the pending bill. It involves the persistence of red-tape which has already defeated so many well-meant efforts of Government officials. Multiplicity of committees sharing responsibility in such a case introduces delay, and affords opportunity for interested parties to exert an influence through plausible objections. Whether done with deliberate purpose to limit our efficiency, or merely for personal pecuniary advantage, the result is the same; it slows us down in producing the materials needed in the War. Incidentally this, more than any other measure yet enacted, was looked upon as offering the small miner a chance to serve his country and obtain a little profit at the same time. The skill to prospect successfully and to produce minerals economically is a valuable national asset worthy of encouragement and reward. Mutilated as the bill appears to have been by the House of Representatives, the advantages it possessed as a democratic measure have been sacrificed, and its effectiveness as a stimulant to production has been seriously impaired.

Incorrigible Mexico

"What can be done to create friendly relations with Mexico?" writes an eastern correspondent. Can anyone answer that question? Our Government has tried to help Mexico; it has coddled and petted Mexico through six long years of turmoil and misrule; it has borne patiently with murder and rapine and insult, in a sincere effort to bring about reforms that should in the end restore political and industrial stability; but it has failed. Mexico today is a centre of political corruption, shamelessly submitting to be used as a base for German activity against the welfare of this country, persisting in the destruction of American interests in her mines and farms, which is accomplished under cover of decrees

that give a varnish of legality to the proceedings. Mexico displays contempt for our nationals and for our Government; it is clear that she construes our long forbearance as an indication of impotence. We have hurled 'ultimatum' after 'ultimatum,' only to follow gentler courses than had been threatened, until her people laugh and refuse to take us seriously. They talk of the heroic Teuton, and call the American craven. It is a pity to have to confess it, but such is the fact. Our Government has dealt gently with them and they translate our kindness into cowardice. When Carranza wrote his first letter to President Wilson several years ago he was a fugitive after defeat in Coahuila, domiciled in Sonora, where he was trying to bluff the State government into accepting his leadership. Villa meanwhile was conquering Chihuahua, and in a half-hearted way was recognizing the long-whiskered chief who claimed to be the defender of the Constitution that he later violated and overthrew. An American had been taken prisoner in the Sierra; our State Department demanded Villa to surrender him; Villa, thinking to be clever, referred our Government to Carranza. That was the first opportunity accorded Carranza to display his diplomatic astuteness. He wrote a letter, which was insolent and petty, quibbling over the division of authority as between himself and Villa, and pointing out that the boundary line in the Sierra was not well-defined. Therefore, he pleaded that the matter of jurisdiction was uncertain, but an investigation would be made, and so on. The American disappeared from sight, the case was settled by delay, and Carranza had scored his first diplomatic triumph. From that time forth lofty impudence has been the characteristic attitude of Carranza toward this country, its President, and its people. We have accepted it, our ultimatums never reached finality, our invasion at Vera Cruz ended in evacuation at the command of Carranza; our invasion of Chihuahua in quest of the evasive Villa, who was sheltered by every Carrancista, made us a joke and a by-word, and ended in withdrawal with nothing accomplished.

It is time that we redeemed the errors of our good nature by no longer suffering our desire for the welfare of Mexico to hold our hand now that she has become a menace to us in the great War that we must win. Carranza understands force. He knew the meaning of it when it overcame him in Coahuila; he will understand an ultimatum from the United States at this time, for we have ceased being pacifists; we are in earnest now to save the world from the Hun, and the voice of President Wilson to a recalcitrant Mexico will possess an unfamiliar harshness that will command obedience. We have had to suspend telephonic communication across the border, because of the nest of German spies using it to obtain information to send to the intelligence department of the Kaiser; we have seen a German raider outfitted openly in a Mexican port; we have seen a great American smelting enterprise forced out of business until it compromised with the exactions of local officials, while its Teutonic rivals flourish in the same so-called republic; we have seen our efforts to enter into a reciprocity treaty waved aside contemptuously; we see oil production threatened by impositions that are meant to hamper us and our Allies, and, if complied with, to make us seem such easy game as to win adherents to the Government through the opportunities offered for graft. Meanwhile Mexico is bankrupt, her citizens are resisting the pet measures of Carranza because his administration has been discredited by corruption; the people in the cities are famine-stricken; the actual control of the Government is limited to the few rosaries of towns along the railroads; but the spirit of genuine reform is present in the nation at large, and all they need is a leader. The surest way to call forth the strong man is to send Carranza a demand for compliance with the old unabrogated treaties, and to follow it with a demonstration that will leave no doubt of the purpose of America to end this nonsense in Mexico. We desire the friendship of Mexico, but we do not possess it. We have given Carranza years of opportunity for reform in his attitude, but his enmity grows deeper and more dangerous. He has even shut off his newspapers from this country so that we may less readily gain information of the schemes afoot in aid of our arch enemy. We cannot afford to permit a neighbor to threaten our well-being. If Mexico will not accept our friendship when offered with the olive branch, she may appreciate it better if offered with the last argument in diplomacy.

We must, however, keep in mind that our country is pledged to stamp out imperialism, that our President has promised to eliminate it utterly from the democratized world that is to arise from the existing conflict, that we are on our honor to establish the principle of self-determination as another of the rights of man. This will govern us in our relations with Mexico, with Central and South America, but it is not too much to pledge again to our Allies and to all the World our word that we will not disregard our high mission by moving our border southward, neither by absorbing more Porto Ricos, nor by conniving at the rupture of another Colombia. We stand convicted of imperialism in the past; in this hour of the trial of democracy and freedom, we must confess that we have given our neighbors in the Western Hemisphere cause to hold us under suspicion. Nevertheless, no one is so blind or so prejudiced as not to recognize the restraint of a benevolent giant in our dealing with Mexico while she was passing through the paroxysms of anarchy. That was hard to endure, in the face of the murders and the shameless atrocities committed against American men and women, and our forbearance under these provocations was not only misjudged by Mexico but by the German militarists. They thought, not that we were "too proud to fight," but too pusillanimous to fight. Our generosity to Mexico helped to encourage the German in his atrocities, which finally led to war. We will not violate our pledges nor rob Mexico of a single square mile of territory, but she has trifled too far with our tolerance by harboring German plotters against our safety. A deep significance lay in Secretary McAdoo's choice of El Paso as the place for announcing at a public address that "the United States has gone to the very limit in dealing with Mexico."



Chlorides in Flotation

The Editor:

Sir—In your issue of March 23 we have noticed an editorial regarding the use of chlorides in testing ores by flotation as conducted by M. H. Thornberry and H. T. Mann of the Missouri School of Mines, the results of which were published in 'Metallurgical & Chemical Engineering'.

Messrs. Thornberry and Mann deserve much credit for their good work, but we question their conclusion that chlorides are distinctly unfavorable to flotation, even when used in conjunction with some other flotative agent such as oil. In testing ores by flotation at the School of Mines laboratories of the University of Idaho, which work is in co-operation with the U. S. Bureau of Mines, it has been found that certain alkaline chlorides and carbonates are beneficial in floating the sulphides of some ores, whereas the opposite effect has been noted on other similar ores from a different mining district. The point that we wish to bring out is that each ore may require a somewhat different flotative mixture, and that the effect of a certain reagent (such as chlorides) on one ore may be different on some other ore. We do not question the results obtained by Messrs. Thornberry and Mann, but wonder whether it is good policy to make such a sweeping statement without first having tested, under like conditions, ores from several mining districts throughout the country. Some millmen who are testing their ores for the flotation process, might conclude, after reading the articles by Messrs. Thornberry and Mann, that chlorides are detrimental to flotation and would, therefore, not consider their use (chlorides) alone as a flotative agent, or in combination with oil or some other reagent. In other words, there is often danger in drawing conclusions from flotation tests in that the reader is apt to be deterred from trying other possibilities.

C. A. WRIGHT.

Moscow, Idaho, April 10. JAMES G. PARMELEE.

Professional Peonage

The Editor:

Sir—I have read the letter appearing in your issue of April 20 with sympathetic interest.

It is but one of the few stray bubbles that rise occasionally to the top of the long-watched simmering pot so industriously stoked by short-sighted employers. There will come a time when the pot will boil over and the burnt employers will break forth into lamentations about the "tyranny" and the "despotic attitude" of the associated engineers. These employers have acquired a large vocabulary of abusive terms in their losing fight with organized labor. Organized labor did not spring forth armed and ready like Athene from the brow of Jove nor was it conjured up by selfish agitators for their own vile purposes, but it was the net product of the greed and short-sighted policy of the employers. History has a way of repeating itself and it is to be expected that the engineers will finally be driven into some sort of an organization whose main purpose will be to secure for its members a just return for the services they render. When that day comes the short-sighted folly of the employers will be definitely manifested. For the engineer is singularly unselfish in his work. He strives constantly to strengthen his capability that he may render better service. His organizations have for their object the dissemination of technical information to the end that the members may be better able to serve their employers. He is actuated by the same spirit that pervades the men of science. He has always aligned himself on the side of his employers and has fought their battles without thought of bettering his own material conditions. And in what measure has the employer responded to this unselfish attitude on the part of the engineer? By reducing him to "professional peonage"!

In your columns under the caption 'Positions Vacant,' I note advertisements soliciting the services of 'mining engineers' at the princely salary of $125 per month. For technical men, mind you! In the Globe district of Arizona, the muckers receive from $140 to $150 per month. One of the employers in this district told me that the qualifications most desired in the mucker are "a strong back and a weak mind." Do not judge from this that the mucker, individually, surpasses the engineer in the esteem of the employer, nor that the employer pays this wage to the mucker out of the largeness of his heart or the generosity of his soul. He has been literally kicked into it. His yielding in this matter is paralleled in the recalcitrant attitude of the young scamp who is dragged into the kitchen by the irate father by the scruff of his neck as a preliminary to the administration of a sound licking.

Unless it is native within him, the engineer emerges from college with but little capacity for dealing with matters of business. His entire attention and ambition is centred upon technical perfection. He is, in a business sense, primarily a job-seeker and a salary-getter. He usually has little ambition to acquire wealth, and less opportunity. He sometimes makes a break to get into the employer class, secures an option on a good property and, more or less timidly, enters the terra incognita of

promotion unwise to the fact that, as a professional man, he is intellectually and temperamentally unfitted for the task. He wriggles hopelessly for a time, goes broke, and proceeds anxiously to scan the column headed 'Positions Vacant.' No doubt, the wise business-man who receives his application has several good hearty laughs at the many blundering departures from the fine art of salesmanship. He may be employed in spite of them, however, but the business-man has been impressed with the idea that it would be a waste of good money to pay this fellow a decent wage, since the applicant is evidently "up against it."

I have a daughter approaching the marriageable age. I am obsessed by a dread lest at some time some bright capable mining engineer persuades her to go with him to the altar, where the minister will pronounce the fatal words condemning her to a life of poverty and anxiety. Before the exigency arrives, I am advising her to demand the union card.

ANOTHER ENGINEER.

Phoenix, Arizona, April 25.

The Supply of Pyrite

The Editor:

Sir—There has been a great deal of agitation on the subject of minerals and ores of various kinds, and in the 'Engineering and Mining Journal' of April 6, Dr. W. H. Nichols states, in referring to the available supply of pyrite for the manufacturing of sulphuric acid, that his company, the Nichols Chemical of New York, has arrived at the conclusion, after examining every known deposit on the Eastern coast, that it will be necessary to go abroad for the lacking quantity. In the same issue, the statistician of the U. S. Geological Survey states that among the enumerated minerals and ores required and available, the productive capacity of pyrite in this country is 33%.

For many years I have been actively associated with copper mines on the Pacific coast, especially in California, and, as we all know, there is hardly a copper mine which with depth, and in cases very close to the surface, is not capable of producing massive sulphide ores that will average at least 40% sulphur, which ores have very little zinc, arsenic, and selenium; and even were it true that in some cases these objectionable elements are present, catalytic acid-making, the present methods of clarifying the roaster-gases is such that almost any massive sulphide of the pyritic type can be used. For chamber acid this is not so necessary, and of this material California has an almost unlimited quantity.

If pyritic ores are so necessary for the manufacturing of supplies necessary for the conduct of the War, why have not the resources of the mines of California been investigated? If pyrite can be imported from Spain, and other foreign sources, it must be done in ships, and as there is less likelihood of these being destroyed by journeying from the Pacific coast to the Eastern coast (due to the under-sea boats of the Enemy) there surely is all the opportunity for supplying a great deal of the tonnage required should a market be given for the sulphur contained at the market price of from 26 to 30c. per unit as given in your metal quotations, to which will be added the copper and small values in gold and silver. Figuring these on the basis of an ore that I have tried to market, and absolutely failed to sell to the smelters in California, to any of the acid works of any consequence, and to the only smelting plant in Nevada, which requires this material (massive sulphide ore), I have been unable to market in any sense whatever an ore that at the present price of copper and silver makes it worth $15.60 per ton. The ore will average 40% sulphur and a greater part will contain 45%. It contains no zinc, but 3.5% copper, with 2.3 oz. silver, 0.03 to 0.05 oz. gold, and only 4% silica. Deducting the usual metallurgical losses, and assuming a selling price of 25c. per unit for the sulphur, this ore is worth $26.35. Assuming a freight-rate from the mine to San Francisco of $1.35 and water carriage to the Eastern coast of $8, and a smelter treatment for the cinder or calcine of $2.50 per ton, there is still $11.85 per ton for mining and for profit.

I have the correspondence bearing on this subject, should it be required to substantiate the statement *that there is not a market on the Paific coast for this class of ore,* owing to the quantity offered from the mines owned by the smelting companies. I shall be glad to submit the letters for publication.

I know of other mines and excellent prospects, as do all the well-informed miners who are familiar with the copper resources of California, which can and will produce about all the tonnage that railways and ships can carry should you or some other public-spirited citizen agitate the subject and call the War Minerals Committee's attention to what you have at home, and put to use and to work the resources in your State.

What is needed is a central exchange in the shape of a crushing and sampling mill on the water-front, with the ability to purchase these ores as received, store the same, and load in bunkers for ships seeking a cargo.

When in the management of one of the large sulphide mines just at the beginning of the War, I made such an arrangement to ship to the Tacoma smelter, and the same location and arrangement are available again.

Should you make inquiry from the miners of California, and should a market as mentioned be established, I will guarantee to show a tonnage of acid-making material, other than the pyrrhotite ores in the southern part of the State, that will go largely to relieve the wants of the Eastern acid-makers.

The lower grades, so far as metals are concerned, should be considered, and I do not hesitate to say that thirty to fifty thousand tons per month can immediately be furnished, provided ships are available, the Panama Canal route, of course, to be chosen. Should there not be the smelting capacity in the East for the calcine, this can readily be supplied, as I did for the Peyton Chemical Company.

E. H. WEDEKIND.

Reno, Nevada, April 24.



HYDRAULIC MINING, WITH MONITOR AND ELEVATOR, IN ALASKA

The Gold Industry and the Gold Standard

By HENNEN JENNINGS

Gold attracted the attention of primitive man by its color, lustre, and indestructibility. The earliest mining and metallurgical operations of which traces remain were those in Egypt that dealt with the ores of gold. From pictorial rock-carvings in Upper Egypt, as also from Egyptian hieroglyphics, it is found that the search, desire, and use of gold extended back some 3000 to 4000 years before the Christian era.

Starting with use as an ornament, gold soon became the trading counter and has been an emblem of value to the human race as far back as history extends. Appreciation of the value of gold has been maintained through the centuries by the difficulties connected with obtaining the metal.

With early primitive methods, only the gold most abundant and easily worked and visible was first sought and this was found principally in alluvial deposits, but as knowledge, mechanical skill, tools and appliances were developed by the human race gold mining was extended to more difficult alluvial, vein, and lode deposits.

Gold, when it became the counter of trade and a measure of possession, was the most eagerly sought of all possessions, and thus it became the pioneer and stimulant to mining, metallurgy, and chemistry. The search for this precious metal became so intense that the alchemists sought its transmutation from other metals, which, though they failed to accomplish, won them other knowledge and gave birth to chemistry.

The trading value of gold has been stabilized by history in that no superabundance was ever obtainable and it has always been necessary to expend labor and intelligence to an extent largely commensurate with the bartering value of the gold obtained.

Accurate records do not exist of the actual outputs of gold in early times, but certainly they must have been small from a modern standpoint. Great outputs of gold, as of all other metals, are a matter of recent times. It has been officially estimated that the world production of gold since the discovery of America, in 1492, to the end of 1916, a period of 424 years, was $16,601,641,319. The output since 1894, a period of 23 years, was approximately $8,500,000,000, or slightly more than 50% of the total mined in 424 years. The average yearly production up to 1894 was $19,107,644, while since 1894 to date it has averaged $369,565,217 per year.

The gold available as a reserve in 1894 has been estimated at $3,965,900,000. The loss of gold and its absorption in the arts and manufacture of jewelry accounts for the differences between the amount produced and the amount on hand. The amount of gold used in the arts has increased since 1894, and of late years it has been between $50,000,000 and $100,000,000 per annum. Estimating the consumption and loss of gold since 1894 at $2,000,000,000 the amount of gold at present in reserve may be roughly estimated at $10,500,000,000.

The concentration and portability of this wealth can be appreciated by converting it into tons weight, for the total tonnage of the entire gold reserve of the world does not amount to over 17,000 tons and it could be easily transported around the world in a large steamship.

Gold, as also silver, has advantages as money-counter owing to large value in small volume, ease of transportation, divisibility without loss, beauty, brilliant lustre, great durability, ease with which they can be guarded, and the difficulty of counterfeiting.

The function of the various mints of the world is to give guarantee of the weight and fineness of the gold they coin. The United States dollar contains 23.22 grains of gold and 2.58 grains of alloy, making a total weight of

*By courtesy of the Director of the U. S. Bureau of Mines.

25.8 grains, or 1.677 grammes, and its fineness is 900. Gold coins of all nations, under normal conditions, are exchangeable on the basis of their content of fine gold.

A broad outlook on modern mining and a study of the output curves of metals since the discovery of gold in this country, in 1849, in Australia, in 1851, and in the Transvaal, in 1886, indicates that big mining is surprisingly modern and that great outputs of other metals have been pioneered by gold. Until the last few years, gold outputs have shown a parallelism with those of coal, iron, and copper, with the growth of railways, and the deposits in our banks. It would seem that the outputs of coal during the last 18 or 20 years; of iron, in 15 years; of copper, in 13; and of petroleum, in 11 years, were greater in aggregate than the output of these products for all previous history.

The mineral outputs of modern times have been rendered possible only by the advance made in invention, engineering, chemistry, and business organization. Even so, it would now appear that the gold output of the world has about reached its zenith, and is giving indications of future decline, as shown by the returns for the past ten years, as under:

1908	$442,476,900	1913	$459,941,100
1909	454,059,100	1914	455,705,000
1910	455,239,100	1915	468,724,918
1911	461,939,700	1916	457,006,045
1912	466,136,100	1917	430,000,000

The extreme variation of output during this period is not great, but on the basis of the estimate for 1917, a drop of 6% is seen from the previous year.

The gold production table appended gives the gold returns from all countries of the world from 1912 to 1916, inclusive, with relative percentages for the pre-war year 1913. See Table A. The percentages given are based on the 1913 production with normal mining conditions, when the Allies produced 91.3%, the Central Powers 0.6%, and the neutral countries 8.1%.

The table shows that gold has been mined in about 60 different countries, and in all the continents of the world. It has been found in the oldest rocks and in almost all subsequent geological formations. Traces of gold have been proved to exist in sea-water, so the distribution of gold is most widely spread, but never in quantity compared with other metals. Exceptional occurrence and favorable natural and commercial conditions are required for its profitable extraction.

The relative production of gold from all countries is given in percentages for the pre-war year 1913, and on a war basis they can be classified as, Allies, Central Powers, and Neutrals, with percentages as follows: Allies, 91.3; Central Powers, 0.6; Neutrals, 8.1. Of the Allies, it is seen that Great Britain, with her dominions and dependencies, produced 62.6%; United States 19.3%; and Russia 5.8%.

The main gold-producers of the world rank in order thus: Transvaal, United States, Australasia, Russia, Canada, and Rhodesia.

Australasia's gold output from 1851 to 1903 amounted to approximately $2,060,000,000. The output in 1903 was about $87,000,000, but since then production has decreased gradually until in 1916 it amounted to only about $39,000,000, or 45% of the production in 1903. There is at present no indication of any large increase of output in the future.

The Canadian gold output was very small in 1891, but mounted rapidly until 1900, when the Yukon placer workings seemed to have reached their maximum; in that year the Canadian districts produced $28,000,000. Since 1900 there has been a fluctuating downward tendency. The years 1915 and 1916, however, show some increase; the production for 1915 being $18,977,901 and that for 1916, $19,234,976. War conditions are unfavorable for exploitation or new discovery. The extent of territory and natural conditions are such, however, as to give hope of future greater outputs.

Russia's gold statistics are open to doubt. It would appear that gold has been worked in the Ural district since 1820 and that in the last 12 or 13 years outputs have varied from $35,000,000 to $22,000,000 a year. Some engineers express the belief that Siberia has greater possibilities for future discovery and exploitation of gold, as also of other metals, than all other regions in the world. At present, in view of war and industrial conditions, the prospect of large outputs of gold in the immediate future is uncertain.

Of the South American and Central American regions, Mexico is the most important. The revival of gold mining commenced with a small output in 1890, the maximum production being reached in 1911 with an output of $29,200,000. Owing to the revolution in that country the output has dropped to $7,690,707 in 1916, which was a million dollars increase over 1915. When the country is in better political and economical condition there is good ground for hoping for increased returns.

In other parts of Central and South America the outputs have not been large, but there yet remain large stretches of unexploited territory and abandoned properties that may be found profitable to work.

The following tabulated statement for the Transvaal is given in full, as it is the most complete record of gold-mining operations in the world. The yields, working costs, and dividends, from 1887 to 1916, a period of 30 years, have been obtained by sworn statements to both Boer and British governments. See Table B.

The total output for these 30 years was £492,198,901, or about $2,300,000,000. The return for 1916 was £38,107,909, or about $185,000,000, which was 40% of the world's output for that year. The dividends amounted to 24% for the whole period, but only 18.6% for the years 1915 and 1916.

There has been a great struggle to lower expenses, which have been reduced from 42 shillings to about 17s. per ton. The average yield has been downward, and fell from 49 to 26 shillings. It would seem that the Transvaal has reached its maximum output and is on the downgrade.

The gold mines of the Rand are greatly favored by the fact that coal is found in close proximity to the gold.

Table A. World's Production of Gold, 1912 to 1916, Inclusive

(Compiled from the reports of the Director of the Mint, U. S. Treasury Department)

	1912	1913	%	1914	1915	1916
North America:						
United States	$93,451,500	$88,884,400	19.3	$94,531,800	$101,035,700	$92,590,300
Canada	12,648,800	16,598,900	3.6	15,925,000	18,977,901	19,234,976
Mexico	24,500,000	19,308,800	4.2	19,308,800	6,559,275	7,690,707
Central American States	3,030,400	2,721,700	0.6	2,293,800	2,970,271	3,517,597
South America:						
Argentina	107,300	2,600	0.0	2,600	.....	6,330
Bolivia and Chile	175,000	175,000	0.0	175,000	814,418	396,922
Brazil	3,570,600	2,254,700	0.5	2,698,200	2,424,515	2,424,515
Colombia	2,971,700	2,971,700	0.6	4,678,600	5,453,148	6,173,867
Ecuador	406,500	406,500	0.1	406,500	545,674	545,674
Peru	492,200	492,300	0.1	492,300	1,109,891	1,179,537
Uruguay	111,000	29,900	0.0	29,900	11,836	11,836
Guiana— British	879,800	1,353,500	0.3	1,126,500	923,892	767,525
Dutch	407,300	470,400	0.1	503,400	449,054	438,223
French	3,050,600	3,050,600	0.7	3,050,600	1,959,793	1,959,793
Venezuela	623,500	444,800	0.1	444,800	1,395,349	1,424,930
Europe:						
Austria-Hungary	2,043,200	2,179,300	0.5	2,179,300	1,392,465	1,392,465
Finland	.....	900	0.0	900	.....	.....
France	1,812,100	2,127,400	0.5	2,127,400	1,400,000	1,000,000
Germany	78,100	135,600	0.0	135,600	.....	.....
Great Britain	27,800	17,900	0.0	17,900	19,266	19,142
Greece	.....	.....	0.0	.....	.....	.....
Italy	11,000	17,200	0.0	31,100	2,295	2,295
Norway	.....	.....	0.0	.....	.....	.....
Portugal	2,300	2,300	0.0	2,300	661	661
Russia	22,199,000	26,507,800	5.8	28,587,000	26,322,746	26,322,746
Servia	251,100	328,000	0.1	116,000	.....	.....
Spain	.....	.....	0.0	.....	.....	.....
Sweden	20,300	17,600	0.0	17,600	25,323	25,323
Turkey	500	500	0.0	500	475	.....
Australia:						
British New Guinea	.....	377,200	0.1	377,200	.....	.....
New South Wales	3,416,900	3,093,200	0.7	2,573,800	2,738,958	2,235,556
Northern Territory	110,300	64,500	0.0	52,300	20,351	17,281
Queensland	7,192,700	5,493,200	1.2	5,134,800	5,161,911	4,447,793
South Australia	136,300	135,500	0.0	129,200	125,701	86,399
Victoria	9,925,200	8,990,800	1.9	8,541,900	6,802,359	5,305,282
Western Australia	26,514,900	27,165,700	5.9	25,487,800	25,014,928	21,941,044
New Zealand	6,428,100	7,102,700	1.5	3,870,700	8,740,567	6,048,992
Tasmania	785,000	690,400	0.2	542,500	383,402	326,408
Asia:						
British India	11,055,700	12,178,000	2.6	11,378,400	11,522,457	11,206,509
China	3,658,900	3,658,900	0.8	3,658,900	2,804,692	2,804,692
Chosen (Korea)	2,852,600	3,582,500	0.8	3,306,600	3,739,477	4,122,351
East Indies— British	1,352,000	1,352,000	0.3	1,352,000	3,100,000	3,100,000
Dutch	3,387,100	3,387,100	0.7	3,387,100		
Federated Malay States	.....	282,400	0.1	269,100	351,527	327,871
Formosa (Taiwan)	.....	814,600	0.2	814,600	1,143,017	1,001,178
Indo-China	74,700	74,700	0.0	74,700	43,659	65,620
Japan	4,467,000	3,614,400	0.8	3,614,400	5,386,066	5,386,066
Siam	56,500	56,500	0.0	56,500	.....	.....
Africa:						
Abyssinia	.....	497,200	0.1	497,200	.....	.....
Belgian Congo	.....	916,600	0.2	916,600	1,029,189	1,029,189
Egypt	.....	95,100	0.0	126,800	144,910	144,910
French Colonies	2,044,600	.....	0.0	.....	.....	.....
French East Africa	.....	.....	0.0	.....	43,414	43,414
German East Africa	.....	253,200	0.1	253,200	.....	.....
Madagascar	.....	1,256,200	0.3	1,075,900	1,381,354	964,980
Rhodesia	14,226,900	14,274,700	3.1	17,423,100	18,915,324	19,232,165
Sudan	.....	192,700	0.1	242,800	.....	.....
Transvaal, Cape Colony and Natal	188,293,100	181,885,500	39.5	173,560,000	188,033,156	192,182,902
West Africa	7,286,000	7,955,300	1.7	8,075,100	8,304,551	7,860,079
Total	$466,136,100	$459,941,100	100.00	$455,676,600	$468,724,918	$457,006,045

Table B. Official Statistics of the Witwatersrand Gold Mining Industry

Year	Tons milled	Yield — Total £	Yield — Per ton s.	Yield — Per ton d.	Working costs — Total £	Working costs — Per ton s.	Working costs — Per ton d.	Dividends £
1887	25,000	81,045	..	..	.....	..	..	12,976
1888	250,000	729,715	..	..	.....	..	..	109,050
1889	575,000	1,300,514	..	..	.....	..	..	430,666
1890	702,825	1,735,491	49	4	1,480,940	42	1½	254,551
1891	1,175,465	2,556,328	43	5	2,221,630	37	10	334,698
1892	1,921,260	4,297,610	44	7½	3,418,290	35	6	879,320
1893	2,215,413	5,187,206	47	0	4,231,848	38	4	955,358
1894	2,830,885	6,963,100	49	2	5,435,816	38	4	1,527,284
1895	3,456,575	7,840,779	45	4	5,793,927	33	5	2,046,852
1896	4,011,697	7,864,341	39	3	6,350,659	31	7	1,513,682
1897	5,325,355	10,583,616	39	7	7,876,435	29	6	2,707,181
1898	7,331,446	15,141,376	41	3	10,293,138	28	0	4,848,238
1899	6,639,355	14,093,363	42	3	11,606,968	..	..	2,946,358
1900	692,413	2,484,247	..	..	2,590,523	..	..	.....
1901	412,006	1,014,687	49	2½	598,874	..	..	415,813
1902	3,416,813	7,179,074	42	0	5,057,948	25	9	2,121,126
1903	6,105,016	12,146,307	39	5	8,800,805	24	9	3,345,502
1904	8,058,295	15,520,329	38	6	11,664,359	24	4	3,855,970
1905	11,160,422	19,991,658	35	10	15,237,309	23	8	4,754,349
1906	13,571,554	23,615,400	34	8	18,049,431	22	2	5,565,969
1907	15,523,229	26,421,837	33	11	19,499,417	20	10	6,922,420
1908	18,196,589	28,810,393	31	5	20,273,620	18	0	8,536,773
1909	20,543,759	29,900,359	28	11	21,361,891	17	1	9,471,391
1910	21,432,541	30,703,912	28	6	19,487,807	17	7	8,876,085
1911	23,888,258	33,543,479	27	11	22,127,618	18	0	7,763,086
1912	25,486,361	37,182,795	29	0	24,504,700	18	8	7,952,994
1913	25,628,432	35,812,605	27	9	22,919,871	17	11	8,194,099
1914	25,701,954	34,124,434	26	6	21,943,692	17	1	8,073,436
1915	28,314,539	37,264,992	26	8	24,657,659	17	5	7,519,416
1916	28,525,252	38,107,909	26	8	25,763,270	18	1	7,095,066
Total	313,117,709	492,198,901			343,248,445			119,029,709

Table C. Production of Gold in the United States

	1914	1915	1916	1917	Rank
Alabama	$12,300	$5,100	$7,000	$4,200	17
Alaska	16,547,200	16,710,000	16,242,000	15,171,300	3
Arizona	4,568,900	4,555,900	4,378,400	5,533,800	6
California	21,251,900	22,547,400	22,110,300	20,815,900	1
Colorado	19,902,400	22,530,800	19,009,100	15,955,100	2
Georgia	16,800	34,800	20,200	6,000	15
Idaho	1,187,200	1,170,600	971,700	711,500	12
Montana	4,143,600	4,978,300	4,575,400	3,756,500	7
Nevada	11,536,200	11,883,700	8,428,200	6,922,900	4
New Mexico	1,219,100	1,460,100	1,403,000	1,025,100	11
North Carolina	130,300	170,700	29,700	15,700	14
Oregon	1,589,400	1,867,100	1,901,600	1,677,400	9
South Carolina	3,200	3,600	300	1,100	19
South Dakota	7,334,000	7,403,500	7,512,200	7,392,600	5
Tennessee	6,400	6,800	6,000	5,300	16
Texas	8,800	1,800	500	900	20
Utah	3,377,000	3,907,900	3,593,400	3,620,300	8
Virginia	300	500	1,300	1,700	18
Washington	587,800	461,600	491,800	434,900	13
Wyoming	6,700	13,900	83,800	200	21
Other States	200	.....	.....	100	23
Total	$93,429,700	$99,714,100	$90,765,900	$83,052,500	
Porto Rico	2,800	700	600	100	22
Philippines	1,099,300	1,320,900	1,549,600	1,404,000	10
Total	$94,531,800	$101,035,700	$92,316,100	$84,456,600	



HOISTING AND CRUSHING PLANT OF THE GELDENHUIS DEEP MINE, JOHANNESBURG



DREDGE ON THE ANCOBRA RIVER IN WEST AFRICA

Also native labor has been moderate in its demands, and outnumbers the white workers nearly 8 to 1, thus allowing skilled white men an opportunity for generous pay, which they have obtained.

The existence of gold in Rhodesia had been known for many years, but material gold returns only started in 1898, and have steadily increased until 1916, when the output amounted to over $19,000,000. There was a falling off, however, in 1917, of nearly two million dollars. The total production from 1898 to 1917, inclusive, amounted to $194,672,165. At the present time the output is depressed by labor and supply conditions, and although the territory for mining operations is vast, with still unknown possibilities, there have been no new discoveries of late.

The total production of gold in the United States has been given by the Director of the Mint as under:

From 1792 to 1847	$ 24,537,000
From 1848 to 1872	1,204,750,000
From 1873 to 1916	2,599,670,200
Total	$3,828,957,200

The yield up to 1847 was obtained from the Eastern coast; from 1848 to 1872, largely from the placer mining in the West; and from 1873 to date, by combination of placer and lode mining and recovery of gold at refineries.

Dredging for gold in the United States dates only from 1896, and since that date the production from this source has been estimated at $120,103,117.

In 1916 the greatest amount of placer mining, including dredging, was done in Alaska, where over 60% of the gold was thus recovered, and in California, where 38% was recovered.

The yearly production of gold in the United States, by States, from 1914 to 1917, has been as shown by Table C.

Although there are enumerated in the foregoing table 23 States from which gold has been taken, the first seven in rank have produced 89.62% of the total for the United States in the past four years. These States, in order, are California, Colorado, Alaska, Nevada, South Dakota, Arizona, and Montana.

The placer-mining operations of the country for 1916 produced about one-fourth of the gold output of this country, and of that one-fourth 56% came from dredging.

All the gold-mining corporations in the United States do not make public their yields, costs, or profits, as is the case in the Transvaal. Our Government does not make demand for such information. Some of the largest and best managed, however, give most complete and generous information, which can be found in the transactions of mining societies, mining journals, and handbooks. There would appear to be no reason for secrecy in gold-mining returns, as it is the one business in the world that does not face competition in marketing its product.

The richest and most easily accessible placer deposits in the United States, as elsewhere, have long since been worked out. Alaska is an exception in that the discovery of placer gold there is of comparatively recent date and guarded by great climatic difficulties.

Placer mining on a large scale started in this country with the discovery of gold in California in 1848. The appliances and methods used were, first, the gold pan, followed by the rocker, long-tom, and short sluice-box, and subsequently by diverting water, shoveling, and washing gravel into long sluices and working on a large scale; then drift-mining, hydraulicking, and dredging.

It has been estimated that an ordinary pan holds about 20 pounds and that 45 to 100 pans per day is a good day's work. With a rocker, two cubic yards, or, say, 3 tons, is a good day's work. The cost of sluice-mining depends on the character of the material, amount of water, grade of the surface, and climate, but it may be said to vary from 20 cents to a dollar per yard for temperate climates.

In Alaska, gravel is subject to a preparative cost for thawing, amounting to 20 cents or more per cubic yard. Drifting, that is, underground mining of a thin layer of gravel and the bedrock adjacent, varies in cost from one to three dollars per cubic yard, and in Alaska as high as from four to five dollars.

Hydraulic mining, that is, the concentration of water under great pressure on banks of gravel, with provision for the removal of the washed material and recovery of the gold, varies from 2½ to 12 cents per cubic yard, and in Alaska up to 25 cents.

Dredging was instituted to work gravel deposits that could not be worked economically by other methods. It can be employed successfully only when a great number of favorable conditions exist, in which case remarkably low costs rule—from 4 to 9 cents in California, and up to 33c. or over in Alaska.

Lode or quartz mining in the United States and Alaska produces 75% of the output. For the world, the percentage is much greater. In South Africa practically all the output is from this source, and shafts as deep as 5000 ft. have been sunk on the Rand to develop the conglomerate deposits. In the United States lode mining has been conducted in a great variety of formations and in deposits varying from narrow veins of banded quartz with high yield per ton to great irregular masses of low-grade ore. The gold is often associated with tellurium and other metals. When pay-ore has given out at shallow or moderate depths, explorations to depths of 4700 ft., or more, have often been justified.

The treatment of the ores depends upon their richness and association with other minerals, and the processes for recovery mostly in use are the jaw and gyratory crushers, for the larger material, followed by stamp-mills, ball-mills, or rolls, for finer crushing, then plate amalgamation, by which in certain ores the greatest recovery is obtained; and concentration by vanners, shaking tables, or oil-flotation devices. The concentrates are treated by smelters, chlorination plants, or cyanide works. After stamping or amalgamation the whole pulp is often economically treated in bulk by the cyanide process.

The yields and costs vary in different districts and in different mines in each district. The greatest gold-producers have been mines of low or moderate yield per ton, but with great mass-occurrence and good conditions for economical working. The best example of such mining is the Homestake mine in South Dakota, which has been working since 1875, and has produced over $147,000,000, the ore not averaging over $4 per ton and costs ranging from 2½ to 3 dollars per ton with dividends of $40,000,000 or 27% of the total output.

The records of the Alaska Treadwell group of mines, started in 1885, showed that up to June 1916 there had been crushed and treated 26,000,000 tons, yielding $63,000,000, or $2.37 per ton, and at a cost of $1.42 per ton. The workings were extended to a depth of 2300 ft., some of them under the sea and the majority of the mines were flooded with water on April 21, 1917, and are now closed.

Lower yields and lower costs have been obtained by the Alaska Juneau and the Alaska Gold companies, which are only a few miles distant from the Alaska Treadwell mines. Working on a large scale has only been started at these mines recently. In 1916 the Alaska Gold Mines crushed nearly 2,000,000 tons, giving a yield of 97 cents and at reported costs of 73 cents. The Alaska Juneau's large mill has only recently been put into operation. It is anticipated that the yield and cost will be still lower. These are the lowest yields and costs known in gold mining. Hydro-electric power is used and all natural conditions are ideal for cheap working.

The Mother Lode in California, on which a 10-stamp mill was started in 1852, has been prospected or worked over an area of 125 miles, and has produced, according to estimates, over $230,000,000 in gold. At two of the mines shafts have been sunk to vertical depths exceeding 4000 ft. Many mines, however, have been abandoned at moderate depths owing to failure to make them pay. The early returns per ton from the Lode were much higher than recently, for they do not average over $4 per ton. Some abandoned mines have lately been opened up again and by hydro-electric power and better system of mining and management made to yield substantial profit. A notable case is that of the Plymouth Consolidated, in Amador county, re-opened after an idleness of 24 years, liberally equipped by capital and costs reduced to about $3 per ton.

The North Star mine, in California, is a good illustration of a persistent but narrow vein of quartz, worked under good management, and being made to pay moderate profit for a long period. The mine was discovered in 1851, and since then to 1917 has produced 1,470,000 tons, yielding $18,610,000, or an average yield of $12.66 per ton. The total dividends have amounted to $5,137,000 or about 35% of the yield. The returns for 1916 show a yield of $10.42 per ton, with costs at $6.26 per ton.

An example of rich yield, but with short life, is found in the case of the Goldfield Consolidated, in Nevada. Here, within eight or nine years $50,000,000 has been taken out, but the yield has fallen from $38.50 per ton in 1910 to $7.52 in 1916. The cost must have been moderate on account of the magnitude of the lode.

The Portland mine, in Colorado, is another rich telluride mine. It has produced over $40,000,000 with an average yield of $27 per ton. The dividends, however, have not amounted to over 20%, as a great amount of development, dead work, costly mining and reduction have been necessary.

Cost of Mining. I was in California and Montana in December, 1917, where I had an opportunity of discussing with a number of operators, managers, and engineers the effect of the present economic conditions on the future output of gold, as also the proposed excess war-profits tax.

As labor and supplies go up, so must the cost of winning gold be increased, and the purchasing power of gold decreased. An index as to the decreasing purchasing power of gold is obtained by noting some of the increases in cost of supplies used in its recovery, some of which are given in the table below.

The advance in the cost of hydro-electric power has been small. The cost of coal and petroleum varies in different localities, but where necessary to use, is a serious item. The increase of costs is as follows:

	%
Labor	(about) 20
Steel (in California)	40 to 280
Manganese-steel (largely used in dredging)	130
Explosives	75
Quicksilver	93
Lumber	125
Machinery	75
Miscellaneous	10 to 200

Some companies with liberal margins between profit and loss can continue to work under present, or even much worse, conditions of labor and supply, but the excess war-profits tax may so operate as to induce them to curtail output. Some of the mines working on a narrow margin are being closed down gradually and others may be kept going for a time by reducing development work and up-keep of plant, and generally marking time while hoping for better conditions.

There has been a fear among operators that through the workings of the Priority Board there may be difficulty in obtaining transportation and other necessaries to keep the mines in constant operation. The amount of tonnage that gold mining calls for from the railroad, where hydro-electric power is used, is very small, as the finished product is concentrated. It would also work a great hardship in the gold-mining industry to close down the works and compel the elderly and less efficient workers that have not already been tempted by higher wages to seek employment and remove their families from the district in which they have spent a large part of their lives.

Excess War-Profits Tax. This has been somewhat of a puzzle to many of the operators. The crux of the whole matter is how rightly to determine the rate per cent earned on the invested capital, that is, the result of dividing the net income by 1% of the capital. If the rate obtained is between 7 and 9%, there is no tax to be

paid. If above 10%, it progressively mounts until a taxation of 60% of all net profits can be imposed.

Difficulties at once arise in the interpretation of what is invested capital and what net income, and what are the legal deductions from ordinary income allowable before net income is ascertained. Invested capital may have an inflated showing in some system of accounts kept, while in others it may be over-conservative, in order to provide against the exhaustion of the mine.

The interpretation of the returns and the book-keeping of a gold-mining corporation becomes a most serious matter. It would seem from a reading of the law that a premium is placed on making a showing of high or inflated capitalization; also that large outputs and high yearly incomes are so penalized, especially with low capitalization, that it would become a temptation to decrease outputs and take two or three times the usual length of time for mining the gold, as when once mined all hope for further profit is gone.

To illustrate, let us assume an invested capital of $1,000,000 and a net income of $1,000,000 in sight in the ground and with little hope of more, but to be taken out in one or more years. What is the proper course for the management to recommend to its shareholders? If it is taken out in one year, the rate is 100% and the company must pay the Government $479,400. If in five years, the rate is 20%, and the company would have to pay a tax equal to $23,900 by 5, or $119,500. If in ten years, the rate is 10%, and the company would have to pay a tax equal to $1400 by 10, or $14,000.

Should a small group of miners or prospectors form a small company, of say, $10,000 to $100,000 capital, and expend the entire capital but strike it rich and take out as net profit an amount equal to or more than the capital put in, in such case, would not they be obliged to turn over to the Government nearly half of their profits? And such being the case, is not the search for new gold deposits greatly discouraged by the tax?

It is my view that the elimination of all excess-profit taxes on gold mining and the encouraging of maximum outputs might in reality bring in greater revenue to the Government than the tax; for larger dividends paid to shareholders would mean greater revenue from individuals.

Gold Standard. Almost all countries of the world have as their financial basis the legal standard of gold. Only a few retain the double standard of gold and silver —Italy alone among the combatants. Prior to the War, while there was freedom in trade and inter-communication between the different countries, the prices of various commodities were regulated both from within and without by the operation of the laws of supply, demand, and competition, stabilized by the intrinsic value of gold.

The debts of the principal belligerents at the time of their entering the War and those contracted since their entrance, as also an estimation of additional debts, are given in a rough manner in the table hereunder. They are sufficiently accurate, however, to illustrate the danger of the world's financial situation.

Table D. Debts of the Principal Belligerents

Allies	Pre-War	War	Total to Dec. 1917	Estimate of future annual expenditure
Great Britain	$3,500,000,000	$23,350,000,000	$26,850,000,000	$6,700,000,000
France	6,346,000,000	11,754,000,000	18,100,000,000	4,400,000,000
Russia	4,544,000,000	16,300,000,000	20,844,000,000	5,000,000,000
Italy	2,900,000,000	6,300,000,000	9,200,000,000	2,500,000,000
United States	1,200,000,000	7,000,000,000	8,200,000,000	14,000,000,000
Total	$18,490,000,000	$64,704,000,000	$83,194,000,000	$32,600,000,000
Central Powers				
Germany	$5,000,000,000	$20,650,000,000	$25,650,000,000	$6,000,000,000
Austria-Hungary	4,000,000,000	12,200,000,000	16,200,000,000	4,000,000,000
Turkey and Bulgaria	800,000,000	1,100,000,000	1,900,000,000	350,000,000
Total	$9,800,000,000	$33,950,000,000	$43,750,000,000	$10,350,000,000
Grand total	28,290,000,000	98,654,000,000	126,944,000,000	42,950,000,000

The table shows at a glance the great difference between the debts incurred by the Central Powers and those of the Allies. Taking into consideration the number of combatants and the necessary munitions and supplies used by them, is it not evident that the Central Powers are getting far more value for their debts than the Allies?

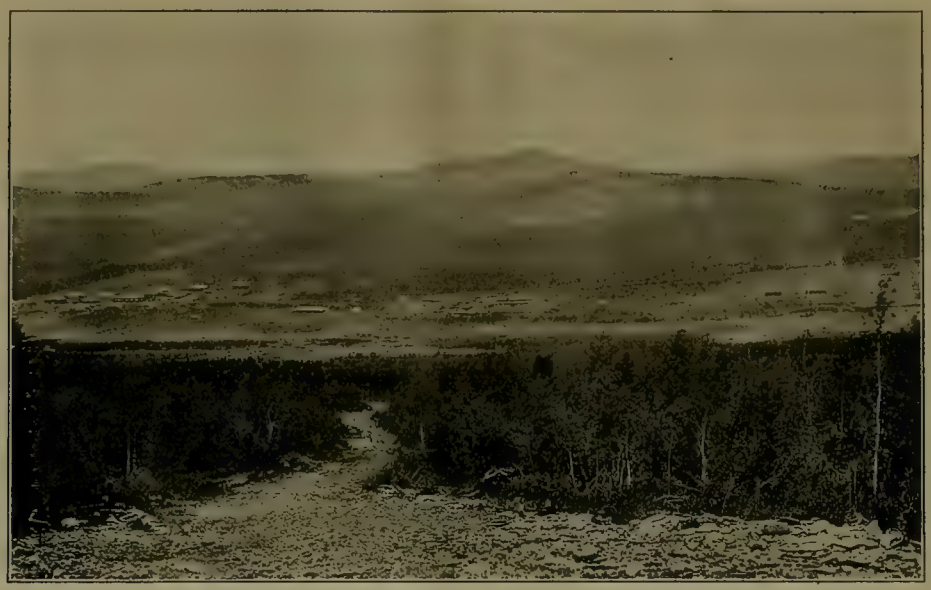
As regards the stock of gold on hand in the world and the amount held by the United States, used as money and security, the following quotation is given from the Report of the Secretary of the Treasury, 1917, page 24:

"The gold monetary stock (coin and bullion used as money) in the United States on November 1, 1917, is estimated at $3,041,500,000. The increase in the past 10 months has been $174,500,000; in the past three years $1,236,500,000, while in the past five years it has been $1,161,333,000. In five years the portion of the world's gold monetary stock held by the United States has increased from approximately one-fifth to more than one-third."

This indicates that the calculation made previously of the gold reserve in this paper corresponds closely with the estimate of the Secretary of the Treasury.

Accepting $10,000,000,000 as the proper gold reserve of the world, it may be calculated that at the beginning of the War the gold reserve was 35% of the total debts of the belligerents, while at the present time, it is only 8%.

Discussion. When prices of labor and commodities are so advanced that it is not possible for the majority of



THE VALLEY OF THE BODAIBO, OR LENA GOLDFIELD, IN SIBERIA



TRAMMING IN THE EL ORO MINE, MEXICO

the gold mines of the world to work at any profit, then labor and supply prices must become lower, or gold becomes automatically demonetized.

Gold coins can be considered storage-cells of human energy, as to obtain them labor of hand and brain must be expended; in fact, they are thus charged with human electro-motive force. They are able to give out strong genial currents of trade confidence, circulating and binding trade, and bringing together different industries and peoples in different lands; their value is not founded on the fiat of any one or more legislative bodies of one or more countries that may be experiencing fleeting prosperity, but they are certificates from Nature of man's work and accomplishment.

The electro-motive force of the storage-battery cells depends not only on the amount of the electricity poured into them, but also its pressure or intensity. In electrical parlance, the rate of flow is known as the amperes and the pressure the volts, while the power, the watts. In the gold cells filled with human energy, the amperes can be considered the number of workers and the volts the forces and tools placed at the disposal of the workers by discovery, science, and organization. The watts may be considered the labor force stored in the cell of coin.

In the mention of the labor elements poured into the cells, it must be understood that labor should include the work of managers, engineers, metallurgists, chemists, overseers, mechanics, and other skilled laborers, as well as the more unskilled work of drillers, trammers, and shovelers.

The electric storage battery of cells can be rendered useless or burnt up by excessive charges of current; they can also dry out and stop working, or be feebly active should there be an insufficient number of cells on the circuit to do the work demanded.

Translating these conditions to the human electro-motive coin-cell, the value of gold can be destroyed by its too great abundance and its too great ease of winning. History is almost uncanny in showing how visions of super-abundance as seen or painted by owners and miners have been doomed to disappointment, and how, considering time and averages, Nature has demanded full toll in labor for her gold.

The electric storage-cell can dry out and disintegrate unless refreshed with new current; this means that should the obtainment of new gold cease while drafts on the old coins are vastly increased, the whole storage-battery of gold energy may get so out of adjustment as not to do useful work and gold would become demonetized and the accumulated labor energy of centuries past, locked up in old coins, become inert and valueless. Should all gold mining stop or radically diminish, this would be the result.

As long as this country, or in fact any country, continues to measure values by a gold standard and pledge its credit on this basis, in the long run the cost of obtaining a new supply of gold must fix its limitations to the rise in wages and commodities. Gold is a sluggish governor and seems at times inoperative, but its plentifulness and cost of winning is ever operative, though not the only factor in the rise and fall of prices. The great value of the gold coin is that it represents a past labor achievement and cannot be duplicated in the future without equivalent labor effort. Promissory bills or notes, or contingent division of profits made by governments, banks, or individuals, can be made mere scraps of paper almost overnight by war, revolution, or commercial failure, but for thousands of years gold, while showing fluctuation in purchasing power, has ever been valuable.

Our government securities and liberty bonds, pledged on a gold basis, take the place of gold coins only as long as the people in this and foreign countries have faith that the Government can make good its promises; when this is seriously doubted by the many, gold will go to a premium.

The great gold reserves of the past would not be so necessary if the recognition of the fundamental necessity of measuring gold-values in units of labor necessary to win it were better recognized and insisted upon by governments that pledge their credit on a gold basis. Safely to lessen gold reserves while upholding the legal gold standard is the great financial problem of the day for this and other countries. To attempt to adjust the value of gold coin by changing its weight in fine gold by government fiat, would be to take away all intrinsic merit from the gold standard and result in confusion and utter lack of financial faith and confidence. The temptation to enlarge obligations and thus reduce gold reserves to an inadequate amount and meet the difficulty by refusing to pay coin for gold pledges also has great financial dangers.

The conception and definition of money has been one of the most fruitful subjects of disagreement, argument, and books known to man. It would seem, however, that the main functions of money are first, facilitating exchange; second, a means of estimating comparative values of commodities.

The unreality of paper money is forced upon me by my study of gold, the happenings of the time, and the outlook for the future. Money must in a large measure be based on sentiment and on good faith, for money, even including gold, has no intrinsic value except as an incentive or stimulant to future human enterprise, effort, and labor. Its stored value vanishes when the mass of the people repudiate it. When faith in it gives out, those that may seize and wish to make new divisions will find only waste-paper in the bonds, notes, and securities so eagerly desired and coveted.

Money can be converted into reality only by working masses led by efficient officers, and who not only make use of the muscular energy of the masses, but harness into service all the impersonal obedient servitors that discovery, invention, science, and engineering have placed at command, which force far exceeds all the muscular energy of man.

The payers of income-tax in 1915 did not amount to more than one-third of one per cent of the population. The envied rich amount to only a fraction of this number. They may enjoy pride of possession in the paper showings of their bank deposits and lists of securities, also the power it gives, but their absorbing power of that

which money can really give to them individually is very small and confined largely to what they and their families can eat, drink, and wear. All other possessions they must share or pass on to others. The rich are merely deflectors, gates, or valves in energy currents. The greatest wealth by the individual has been obtained by organizing labor and producing the necessaries of the many at the lowest prices and taking small profits per unit, but with the greatest number of units. As labor in its broader sense has been organized and stimulated to produce a maximum amount of commodities, it provides for its own necessities and comfort as well as that of the few and makes possible a greater division of such commodities among themselves. Thus great production is beneficial to the many as much as, and in proportion more than, to the few.

The decennial census of 1910 shows that about 93% of the male population of the United States over 21 years of age is occupied in gainful pursuits. A far more difficult problem than the destruction of capital would arise among the workers should the present order of things be suddenly abolished, which would be how a fair, satisfactory, stimulating division of salaries and wages could be arranged and enforced among the workers, so that they would have more leisure and at the same time obtain more wants and necessities.

Any advance in wages of one class of workers must in fairness be followed by proportionate increases in the wages of other classes and as the laborer's wants and requirements for subsistence and comfort are dependable on his fellow-worker, so must the cost of his subsistence increase as his own and other wages are raised. Thus, in the end no material gain can be obtained by labor unless there is some corresponding advance in the output of his work. The Government at the present time is the greatest employer of labor and purchaser of commodities. The danger of allowing the prices of commodities to rise above the future cost necessary for obtaining gold, it is hoped has been made plain. Certainly the Government should insist on the stoppage of all classes of profiteering, but how is it possible to fix prices of any commodity and make low bids possible unless there is some limit fixed upon wages and salaries?

The War must be won and it will take money as well as men to accomplish it. However, it does not help matters to pledge credit unnecessarily to please or placate either labor or capital, and the more we get for money on a gold basis at the present time the less will be the burden of debts incurred on future generations, which must of necessity be paid by the mass of the people rather than the few. The financial integrity of the country has been pledged on a gold basis. As 90% of the gold output of the world comes from the Allies' territories, as a war measure it is plain that it is to the advantage of the Allies to uphold the gold standard. For the past ten years the world's yearly output of gold has been almost stationary, and the present high cost of labor and supplies is acting very seriously against any increased production. To stop gold mining in a time of financial stress, as has been indicated, would be like closing the doors of a bank when a run is made upon it. It therefore must be evident that it is vital for this and all Allied countries to encourage gold mining as far as possible.

Unfortunately but little help can be directly extended to the gold industry, but as far as possible, encouragement should be given and the excess war-profits tax placed upon this industry should be re-considered, for while the War may have proved profitable to every other class of industry in the matter of earnings, certainly it has been seriously injurious to the gold miner.

Indirectly, the gold industry, as well as new issues of Liberty Loan bonds, can be greatly helped by the reduction in prices of all necessary commodities, and this certainly should be seriously, judiciously, and fairly taken in hand by the Government.

The War is to be won by the efficiency, harmony, and morale of the workers behind the firing lines as much as by the exercise of these qualities by the soldiers at the front. The right conception of what gold, and in fact money in any form, has the power of doing, or not doing, seems to me a matter of most vital concern at the present time. A better understanding of this problem, I believe, would tend to knot together governments, labor, and capital and make for efficiency, harmony, and happiness.

Transvaal Mining Statistics

Final figures for 1917, compared with 1916, are now available, showing the following results:

	1917	1916
Stamps crushing	9,470	9,727
Tube-mills grinding	332	321
Ore treated, tons	27,862,851	29,175,468
Value per ton	27s.3d. ($6.54)	26s.9d. ($6.42)
Gold extracted	£38,323,921	£39,484,934
Silver extracted	£122,951	.....
Operating costs, per ton.	19s.4d. ($4.64)	18s.3d. ($4.38)
Operating profit	£10,486,283	£11,881,294
Dividends declared	£6,718,604	£7,271,589
Coal mined, tons	6,641,229	6,136,913

At the end of 1917 there were 31,705 whites and 256,304 kaffirs employed at all the mines throughout the Union of South Africa.

PEAT yields excellent fuel-gas when treated in a special gas-producer. Valuable by-products are recoverable in this process, and after these have been extracted, the gas is exceedingly desirable for the generation of heat and power. This is the most promising field for the utilization of peat. The gas can be compressed so as to cheapen the cost of piping it long distances to the point where it can be most economically utilized.

AMMONIA prices have been fixed by the Food Administration at 8½c. per pound for aqua ammonia in less than carload lots f.o.b. factory, and 30c. per pound for the anhydrous grade. This has been arranged by agreement with all the leading producers, in order to avoid profiteering. If higher prices are quoted, under the conditions stated, the fact should be reported for adjustment by the Food Administration.

Mr. Guggenheim on Industrial Conditions

In the nineteenth annual report of the American Smelting & Refining Co., just issued, Daniel Guggenheim says:

The peak of high prices for metals, excepting that of zinc, was reached during the first half of the year. Since then, there have been very serious declines in all metals, as follows: Copper from 33c. to 23½c., lead from 11c. to 5½c., silver from $1.09 to 78c., and zinc from 13c. to 7½c. These results have been partly brought about by governmental actions.

On the other hand, all our expenses of operations have constantly increased and are still increasing. Everyone is acquainted with the greatly increased cost of fuel. All our supplies and building materials are costing from 50 to 150% more than normally. But our greatest difficulties have been, and are, in connection with the lack of supply and the constantly increasing demand for labor. Therefore, our costs of smelting and refining are greater month by month, but our receipts are fixed.

It has always been the policy of the Company to make long-time contracts for ore and bullion, at a fixed price for smelting and refining; this has permitted continuous running of our works, because plans could always be made intelligently and without risk for enlargement or making expenditures to reduce costs. While the charge in such contracts was fixed, the Company had a certain interest in the metal recoveries. Under economic laws, if costs of operation increased, it would be on account of generally increased values, and the interest of the Company in the metal recoveries would equal the increased cost of smelting and refining.

The Company is now suffering from the entire lack of economic law, and is operating under the direction of governmental commissions, whereby the value of the metal products of the Company is fixed. But the cost of labor and supplies is not fixed; in fact, owing to the various governmental contracts for shipbuilding and other construction of great magnitude, which have been made on the basis of cost plus a commission, the contractors have no interest in holding labor costs at a point where a profit can be made, and, in fact, their own interests are in favor of as high a cost as can be in any way justified.

By these two governmental actions, first, by reducing the value of our product, and second, by constantly increasing our cost, this great corporation, producing what is absolutely necessary to the Government in carrying on the War, is having its ability to pay a fair return to its stockholders seriously jeopardized. While it may be said that the previous profits were excessive, had it not been for such profits, the Company would not have been able to enlarge its works and increase its output, all of which has been of vital necessity to the Government. These enlargements have been effected at a cost of fully $15,000,000, all of which has been taken out of the earnings of the Company, and the enlarged capacity will doubtless be entirely useless after the War demand ceases.

The three smelting works in Mexico, located respectively at Monterrey, Matehuala, and Aguascalientes, were started up in a small way during the first half of 1917, and it is hoped that the smelter at Chihuahua will soon be blown-in. There is no immediate prospect of the smelter at Velardeña being put into commission, or of the mining properties in that section being opened, as bands of bandits are still disagreeably active in that vicinity. None of the very valuable mines of the Company around Chihuahua have been operated as yet, and the same is true with the copper properties around Matehuala. Our smelting works have not been worked to capacity, and the uncertainties as to transportation and fuel, together with the fact that costs have been quite as greatly increased in Mexico as in this country, have not made for a profitable outcome. Nevertheless there has been a gradual improvement in this direction.

Oil-shales in South Africa have been found in the Karroo formation, as developed in the eastern part of the Union, over a very wide area extending from Middelburg in the Transvaal to Nahainkwe in the Matatiele district of East Griqualand. They occur in at least two divisions of the Karroo system, namely, the Stormberg series and the Coal Measure series of the Transvaal and Northern Natal, and at least two horizons in the last-named group of rocks. The existence of the shales has now been known for over 25 years. While no great measure of success has so far attended the efforts of the various companies and syndicates that have been formed to work, or more correctly speaking, to explore the deposits, the prospects of establishing a shale-oil industry appear hopeful. Four areas have up to the present attracted particular notice. They are: (1) the central portion of the Ermelo district of the Transvaal; (2) the Wakkerstroom district of the Transvaal; (3) the north-eastern portion of the Utrecht district of Natal; (4) the eastern part of Impendhle county, Natal. In the three first-named areas the oil-shales occur in the Coal Measure series; in the last named in the Stormberg series. Distillation tests made on shale from Mooifontein yielded from 30 to 32½ gal. of crude oil per ton, comparing favorably with the Scotch shale. In the Utrecht district there is enough shale available to warrant the erection of a 300-ton treatment plant.

Primary aluminum made in the United States in 1917 was valued at $45,882,000, an increase of $11,982,000 over the value of that made in 1916. This increase appears to be due chiefly to an increase in the quantity of metal produced, but in part to an increase in the price.

Solder for aluminum, composed of zinc and tin, the former being in the proportion of two to one, and a relatively small proportion of sal-ammoniac, was recently granted patent No. 1,256,285, to J. J. Aubertin, of St. Louis, Missouri.

Sodium Cyanide

By W. J. SHARWOOD

*The contradictory evidence given by certain 'experts' in a recent sensational murder trial indicates an imperfect realization, even by some chemists, of the fact that commercial potassium cyanide can scarcely be said to exist at the present time, its place having been usurped by the sodium compound. Sodium cyanide is now widely used as a solvent of the precious metals in ore, and in electro-plating. It is also a source of hydrocyanic acid for fumigation, especially in Western orchards where gaseous hydrocyanic acid is applied as an insecticide to individual trees, which are covered with tents during the process.

The sodium cyanide of commerce is one of the purest technical salts now available, containing 96 to 98% NaCN, with less impurity than is found in most samples of potassium cyanide sold as chemically pure. Chemists might with advantage make a point of recognizing the use of sodium cyanide, and call it by that name in their laboratories. As with so many other alkali-metal salts, we can now use the sodium instead of the potassium compound as a reagent, except in the few cases where the potassium ion is essential to the reaction, or where there is some marked difference in solubility. Sodium cyanide not only contains less carbonate and sulphide, but is cheaper, reacts identically with the salts of silver, copper, zinc, etc., except in concentrated solutions, and is more permanent in solution than ordinary potassium cyanide, showing less decomposition and no discoloration on keeping. It has an additional advantage in not being deliquescent.

The alkaline cyanide now sold must be much more poisonous than the old material, which was no doubt the basis of most of the familiar statements as to its lethal effects. Modern sodium cyanide—commercial as well as c. p.—contains 50 to 52% cyanogen, or practically four times as much as the material formerly sold, and is presumably four times as lethal in its action.

Pure KCN contains, by calculation, 39.97% of CN; pure NaCN contains a much higher proportion, 53.07% CN. For most purposes these are taken as 40% and 53%, respectively. As the potassium in commercial cyanide was gradually replaced by the lighter atom of sodium, other things remaining the same, the proportion of cyanogen was correspondingly increased. This allowed manufacturers to make a salt containing a large proportion of impurity, which would still titrate 38 or 39% cyanogen and would be reported on the old basis as 97 or 98% KCN. Pure sodium cyanide, by the same system, would have been reported as 5300/40 or 132.8% KCN. In fact sodium cyanide was sometimes deliberately diluted with inert material (carbonate, etc.) to supply the demand for 98% KCN. At first there was a prejudice against the use of sodium cyanide in gold extraction, some early experiences indicating that it was less efficient, but laboratory tests indicate that equivalent amounts of the cyanides of potassium, sodium, and calcium are equal in effect, and sodium cyanide is now almost exclusively used in the industry. In fact, with the present shortage of potassium, owing to war and other conditions, it would be impossible to supply the potassium compound in anything like the required quantity.

Until recently, however, cyanide has continued to be sold and used on the basis of its KCN equivalent, even if no trace of potassium was present; thus commercial NaCN was commonly sold as 128% KCN, and most works using cyanide also continued to make up their solutions on the basis of KCN. For the past year cyanide has for the first time been generally sold on the more rational basis of its cyanogen, or its actual NaCN, content; thus the highest grade is now offered as either sodium cyanide 96 to 98% or cyanogen 51 to 52%, while the old so-called 98% KCN used to carry about 39% cyanogen. Four pounds of this sodium cyanide are therefore chemically equivalent, and actually equal in effect as a solvent, etc., to about 5 lb. of the old potassium cyanide, and there is a corresponding saving of about one-fifth in freight and storage. There is no reason why all users of cyanide should not accept the rational method of reporting the concentration of their solutions in terms of the sodium cyanide which they actually are using, and discard the absurd fiction of calling it—or translating it into—potassium cyanide, which causes unnecessary trouble in making up solutions, and so forth.

At various times commercial cyanide has been cast as thin slabs, and in large bricks weighing up to 50 lb. or more. Some produced in the wet way has been sold in granular form, and some briquetted. The most recent and convenient system is to cast it mechanically into uniform egg-shaped cakes weighing an ounce each, so that for many purposes, such as fumigation, no further weighing is necessary. It was formerly shipped in boxes with an air-tight lining of sheet-zinc, of 112 or 224 lb. each; tin-plate is now used for lining and 200 lb. is the usual net weight.

For titrating potassium cyanide it has been the universal custom to make up a solution containing 1.303% silver nitrate, so that 1 cc. was equivalent to 10 mg. KCN. This was roughly 0.0767 *N*. For titrating commercial sodium cyanide it is possible, by a convenient coincidence, to use *N*/10 or *N*/20 silver solution without

*Abstract from 'Jour. Indus. and Eng. Chem.', April 1, 1918.

necessitating any calculation. One cubic centimetre of $N/10$ silver solution is equivalent (by Liebig's titration, or using the preferable modification with potassium iodide indicator) to 5.202 mg. of CN, or to exactly 9.802 mg. of NaCN. Now 98 is almost the exact percentage of actual NaCN in the high-grade commercial material now in use. Therefore we can titrate solutions with $N/10$ $AgNO_3$ and call 1 cc. equivalent to 10 mg. of the actual 98% salt, which has to be weighed-out in making-up the solutions. For technical purposes it is perhaps preferable to use $N/20$ solution (1 cc. = 5 mg. commercial NaCN) as the end-point with iodide indicator, it is very delicate, and the burette readings then also indicate pounds per ton of solution directly. For instance: taking a 10-cc. sample: suppose 2 cc. of $N/20$ silver nitrate is consumed; this indicates 10 mg. or 0.10% of commercial sodium cyanide in solution, or 2 lb. per ton of solution. The ton or fluid ton used in hydro-metallurgy is about 32 cu. ft., or the volume of 2000 lb. of water.

When determining sodium and potassium in a mixed cyanide—chlorides and carbonates being the usual impurities—it is often possible to work by directly evaporating with hydrochloric acid, gently igniting, and weighing the mixed chlorides remaining, and titrating chlorine in part of the residue. The following formula, based on 1914 atomic weights, gives the results in the most direct manner possible:

If A = grammes mixed chlorides, and
B = total grammes chlorine in mixed chlorides;
then K in grammes = 2.4286 A – 4.004 B, and
Na in grammes = 3.004 B – 1.4286 A = A – B – K.

Not infrequently the class of cyanide can be determined simply by titrating cyanogen and alkalinity in a freshly prepared solution, using methyl orange as indicator.

It is important, when testing cyanides for the presence of alkaline sulphide, to prepare the solution at the moment of making the test; or, what is better, of dissolving the solid cyanide in the reagent to be applied. If the cyanide is dissolved in water and allowed to stand even a few minutes, the sulphide content may be seriously diminished, and traces of sulphide may be easily overlooked. Three simple methods are available: shaking with fine lead carbonate suspended in water; dissolving the solid cyanide in a solution of silver nitrate containing slightly less than 1 mol. $AgNO_3$ for 2 equiv. CN; or dissolving the solid cyanide in a little mercuric chloride solution. Each of these reagents yields a black precipitate or dark coloration. The sulphide may be quantitatively determined by the silver or mercury method.

While sodium cyanide is not deliquescent, it is decidedly more soluble in water than potassium cyanide. In dilute solutions there is no apparent difference in the stability of sodium as compared with potassium cyanide. In each case decomposition is greatly increased by access of air and retarded by presence of free alkali. Tests indicate that in strong solutions there is comparatively little difference in stability, the advantage, if any, lying on the side of the sodium compound, which lost about 40% of its cyanogen in 38 months, against nearly 50% lost by commercial potassium cyanide.

Manganese Possibilities in Eastern Cuba

While several hundred manganese mining claims have been filed during the past year at the Mining Bureau of this Province, in only a small number has it been demonstrated that they may be profitably operated, even at present high prices for the ore. The lack of proper transportation facilities and of good roads is the great drawback to development of the industry here. With three exceptions the mines have to haul their ore to the railroad in ox-carts and mule-carts, or by pack-mules, a distance of 3 to 15 miles, and at a cost of $3.50 to $10 per ton. As most of the ores are low grade, and practically none comes up to the standard of 48% metallic manganese, it is difficult to operate at a profit under the conditions that exist. The roads that are available during the few months of the dry season become practically impassable in the season of abundant rainfall, usually from April to November. Some of the American mine operators are now using motor-trucks and tractors for transportation of ore, and it is hoped that by this means some of the difficulties may be overcome.

The manganese mines or claims of this Province may be divided into nine groups: Cristo, Ponupo, San Nicolas, Palmarito, Los Negros, Santa Rita, Guisa, Sabanilla, and South Coast. The most important are the Ponupo and Cristo. The Ponupo produces at present about 5000 tons of ore per month. It is chiefly low grade, averaging from 38 to 40%, and is rather low in silica and iron. As this group is near the line of the railroad, the ore is mined and shipped at a profit under present prices. The Cristo consists of several small claims at present producing 4000 tons of ore monthly. The mineral is slightly higher in manganese and about the same in silica and iron as the Ponupo ore, but the greater part of it requires washing. The Palmarito and Los Negros groups produce each about 1000 tons monthly. The ore from them is high grade and low in silica and iron. Considerable modern machinery has recently been installed at the San Nicolas mines, and it is expected that several thousand tons monthly will soon be produced from this group. The remaining four groups have a combined monthly production at present estimated at 1000 tons, making the total for the Province approximately 12,000 tons monthly, all of which is exported to the United States through the ports of Santiago and Nipe. The declared exports of manganese ore from the Province of Oriente in 1917 were valued at $567,849, of which a large proportion was shipped through the port of Santiago de Cuba, and the remainder from Antilla (Nipe).—'Commerce Report', March 27.

GOLD EXPORTS to Mexico according to official figures were $1,884,813 against imports of $440,603 in December.

Improvised Flotation Dryer

By S. PAUL LINDAU and W. E. EVANS

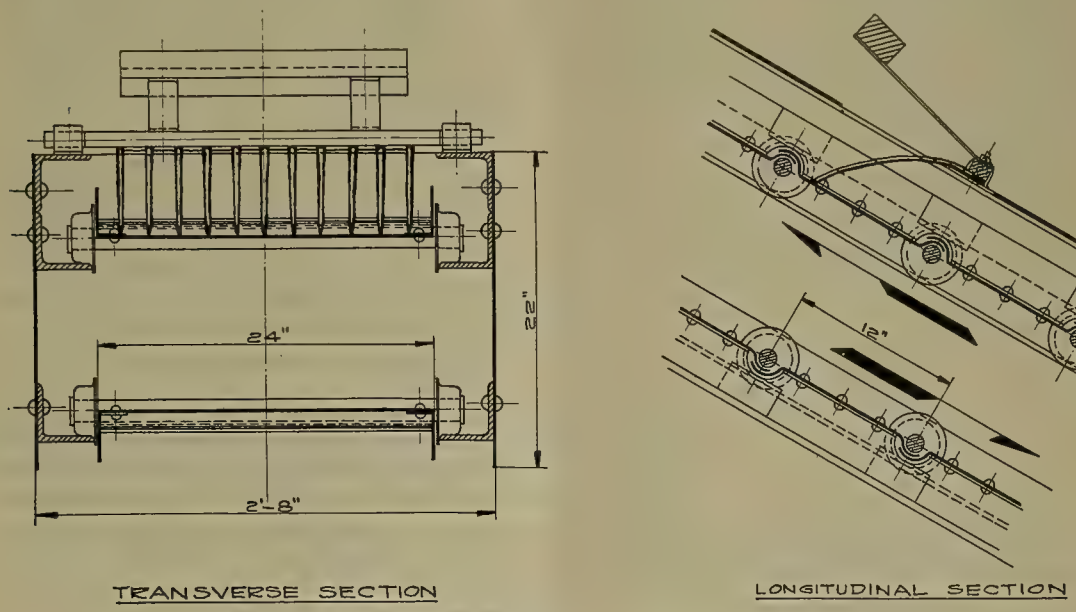
The flotation concentrate reaching the smelter of the St. Joseph Lead Co. at Herculaneum, Missouri, at times contains from 12 to 15% water; this must be dried or reduced to about 6 to 7% before incorporating it into the regular Dwight-Lloyd sintering charge. One method of accomplishing this is to unload the material on stock-piles, and depend on natural atmospheric agencies, the length of time depending on the time of year and kind of weather.

A more satisfactory method is now being employed on part of this material with great success. This method is as follows:

An old discarded pan-conveyor, which was formerly used in the now extinct 16-pot Savelsburg process plant, is utilized. This conveyor is 125 ft. long, with pans 24 by 12 in., having overlapping ends. This is placed at an incline of 30°, running at a speed of about three feet per minute. There are six oil-burners evenly spaced, underneath the ascending and above the descending pans, to supply the necessary heat. The conveyor is housed on top and sides, thus retaining as much heat as possible. A shovelful of the wet concentrate is placed on top of each pan; as this material travels upward it is broken ten times by passing under the prongs of old coke-forks that are weighted at one end, causing the prongs to scrape along the surface of the conveyor. The material is discharged into railroad cars and taken to the ore-bins.

This dryer has a capacity of 50 tons per 24 hours.

[The success of this method of drying flotation concentrate depends upon the cost of the oil used to obtain the necessary heat. The consumption of oil is at the rate of 20 gallons per ton, at a cost of 5 cents per gallon, equal to $1 per ton of concentrate. These were the figures quoted last October.—EDITOR.]



THE DRYING PLANT FOR FLOTATION CONCENTRATE IN USE AT HERCULANEUM



A PAN-CONVEYOR DRYING-MACHINE FOR FLOTATION CONCENTRATE

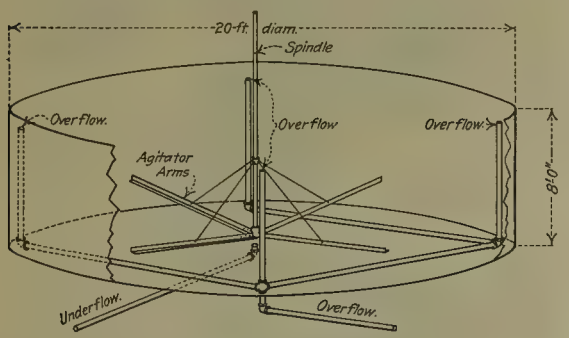
ZIRCONIUM is being used to make a high-speed alloy for tools, containing 1.5% Zr with Si 6, Al 6, Ni 86.4, and C 0.1%. The alloy was developed by G. L. Kelley and A. H. Miller for the Midvale Steel Company.

Converting an Agitator Into a Continuous Thickener

By V. T. EDQUIST

*Vacuum-filtration was superseded by continuous decantation at the Yuanmi gold mine, Western Australia, early in 1917. The ore contains arsenical pyrite and antimony sulphide. It is roasted, ground fine, and agitated with cyanide. Dissolved losses in the residue made some change necessary, so decantation was successfully tried. The operation is dilution of pulp, followed by part dewatering, using two 20 by 8-ft. mechanical agitators as continuous thickeners. By repeated dilution and dewatering of pulp, the originally contained gold solution is almost entirely removed. This is the C. C. D. process as known in America.

To convert an ordinary 20 by 8-ft. agitator into a continuous thickener, the bevel-pinion and crown-wheel driving the agitator-arms were removed, and a worm and worm-wheel substituted. This reduced the speed to 1 r.p.m. The supporting stays were shortened, and the



DETAILS FOR AGITATOR-THICKENER

agitator-arms bent up so that the ends were raised about two feet. A hole was cut in the vat-bottom as near the centre as possible, and a 4-in. plug-valve flanged on. From this valve a 3-in. pipe leads away to the desired point of discharge.

After starting, the natural settlement of slime under the bent-up agitator-arms forms a smooth bottom sloping to the centre. The overflow-pipes are arranged as shown in a sketch. The pipes are placed near to, but not touching the side of the vat, and the length of the moving agitator-arm is regulated so as to clear them. The upper end of each vertical pipe is threaded, and an easy running socket screwed on. By screwing these sockets up or down the height may be regulated exactly, and an even overflow obtained. This arrangement gives an overflow from four points a few inches from the side of the vat, and dispenses with the costly annular overflow-channel. The agitator lifting-gear remains unaltered, so that the spindle and arms may be raised or lowered as occasion demands.'

*Abstract from 'Monthly Journal,' Chamber of Mines, Western Australia, November 30, 1917.

The capacity of one of these 20 by 8-ft. thickeners on Yuanmi roasted ore-pulp, when the ratio of solution to solids in the feed is 5 to 1, the underflow 1 to 1, and the overflow clear, is from 100 to 110 tons per 24 hours.

The total cost of the complete conversion from vacuum-filtration to continuous decantation was £189 ($907).

Signs

By CECIL W. LEARY

Some men seem to take a secret delight in that old school-boy prank of defacing and mutilating sign-boards. In the mines they pick on the signs along the drifts, and it seems that when they have a minute or two to spare they burn or scratch out letters so as to deface them.

On several occasions I have overheard men laughing and talking about the way in which they had changed signs from one drift to another, and what a good joke it was to watch the greenhorn get on the wrong track. I appreciated the joke, but if a fire had broken out about the time they were playing their little prank it would not have been so amusing to these men to know that they had been the means of spoiling the greenhorn's only chance of getting out.

These signs are not an order, nor a command from a shift-boss, and you are not spiting the company when you deface them. They are put in place for your, and your fellow workmen's welfare. If you have an occasional moment to spare, use it in making the place safe or in giving the greenhorn advice that will help him.—'The Anode', March 1918.

ALUMINUM SULPHATE, used for water filtration, is sold on its water-soluble aluminum content, and on the excess of $Al_2O_5H_4$ over what is required theoretically to combine with sulphuric acid. Estimated on the basis of 17% Al_2O_3 at 2c. per lb., an alum with 19.5% Al_2O_3 is worth $\frac{1}{3}$c. more, and an alum with 12.8% Al_2O_3 is worth $\frac{1}{2}$c. less. A good basic aluminum sulphate should be in lumps from a half inch to two inches in diameter; it should contain not less than 17% water-soluble aluminum calculated as Al_2O_3; it should have a basicity ratio of 0.03, that is, it should contain 0.5 to 1% more Al_2O_3 than is theoretically required to combine with the sulphuric acid present; and it should have less than 1% total iron. The process employed for manufacturing aluminum sulphate consists in mixing bauxite with sulphuric acid in lead-lined tanks, then boiling for six to eight hours. The solution formed after the reaction between bauxite and acid has taken place, is a mixture of $Al_2(SO_4)_3$ and silica. In order to obtain a clear solution it is necessary to filter the mixture, which is difficult, tedious, and costly. The alum solution is next boiled to expel the excess of water. After being concentrated from a density of 25° or 30° to 50° or 60° B., the solution is discharged into trays. On cooling it crystallizes as alum cake. This is crushed, and is shipped in bulk, barrels, or sacks.

Silver Bill Debate in the House of Representatives

*Mr. Glass. Mr. Speaker, when this measure was originally drawn some months ago, it was designed to meet and overcome the difficulty that had risen in our foreign-trade relations, involving a rather serious discrimination against this country in the matter of foreign exchange. Importers of many necessary articles were subject to great loss by reason of the depreciation of the American dollar in neutral countries in Europe and Asia, particularly in Spain and the Scandinavian nations, as to Europe, and in the Orient, India and China. In that view it was not an emergency measure. But within the last 10 days circumstances, of which I am not at liberty to speak in detail, have arisen which make action by Congress imperative. For that reason the bill, by unanimous action of the Committee on Banking and Currency of the other body, was presented to the Senate, and, without division, passed. It was taken up for consideration on Friday and Saturday of last week by the House Committee on Banking and Currency, and, at an exceptionally largely attended meeting, unanimously ordered to be reported to the House. In our trade relations with the Orient, and particularly with India, we are put to the necessity of paying our balances in metal, and, on account of the large importations of jute, burlap, and other materials used in the handling and distribution of our crops, we are obliged to meet a large exchange balance to our very great disadvantage. It shall be necessary for this country to ship to India, for the next ensuing 16 months, at least, about $100,000,000 of gold to meet our importations, or otherwise to do what this bill proposes to do, borrow from the Treasury the only available stock of silver in the world at this time, and ship it to India to meet trade balances. It is not necessary to say to the House that, gold being our primary money, every dollar of it that we shall export circumscribes our ability to meet the extraordinary commercial requirements of our own country at this time. In short, if we do not pass this bill immediately, we may be put to the necessity of shipping gold rather than silver to India. I transgress no propriety and reveal nothing that should not be disclosed to the House when I say that the governor of the Federal Reserve Board stated to the committee that the board had already felt obliged to give the large imports of jute, burlap, and other materials which we are obliged to have the assurance that if something of this sort should not be done immediately by Congress the Federal Reserve Banks would assure them the gold necessary to meet trade balances. The bill provides that there shall be a retirement, gradual or immediate, as circumstances may require, of $350,000,000 of outstanding silver certificates; and as those silver certificates are retired a like amount of silver coin in the Treasury, held as a cover for the silver certificates, will be broken up and melted into silver bullion and sold by the Secretary of the Treasury to meet foreign exchange exigencies and to avert serious trouble in India. The Congress knows that India uses not exclusively, but almost exclusively, silver as its metallic currency. Any deficiency in the circulating medium that may be occasioned by the gradual or speedy retirement of $350,000,000 of silver certificates is to be met by the issuance, under authority of the Secretary of the Treasury of the Federal reserve bank-notes, based on short-time gold certificates and notes of the United States. When the emergency shall have passed or the War ended, the Secretary of the Treasury is authorized to purchase an equivalent amount of silver to that which may be utilized in this transaction to replace the silver thus loaned to the British government, and used for foreign exchange purposes, by the re-coinage of a like amount of silver dollars, upon which may be issued a like amount of silver certificates.

Mr. La Follette. The gentleman stated that there would be a trade balance of $100,000,000 in the next 16 months between this country and India. That accounts for $100,000,000. Why the other $250,000,000?

Mr. Glass. The other $250,000,000 is to meet foreign exchange accounts with other countries and especially is to be used to counter an exigency that vitally affects our Allies in the conduct of the War. Just in the degree that it vitally affects them it vitally affects us. I will read to the House a telegram that was sent to me from Deming, N. M., while I was absent from the city attending the funeral of my late colleague, Mr. Jones, by Secretary McAdoo in which he says:

"A war emergency of the utmost urgency makes the prompt passage of the Pittman bill imperative. I commend this subject earnestly to the consideration of yourself and your associates on your committee. Will you please permit Assistant Secretary Leffingwell to lay before you my views about this matter?

William G. McAdoo,
Secretary of the Treasury."

Mr. Moore of Pennsylvania. It is a situation affecting our Allies at least equally with the United States?

Mr. Glass. It is a situation we are obliged to meet. It is rather distressing to the chairman of the Committee on Banking and Currency to feel compelled to bring to the House a measure all of the details of which he is not at liberty to discuss fully, and to ask the House, upon its faith in him and his associates of the committee, acting as a unit, to accept the bill, but that is precisely the situation. Upon my return to Washington on Saturday, I found that the Committee on Banking and Currency had had a meeting and such hearings as were possible. In addition I personally made inquiry in every responsible

*Excerpt from Congressional Record, April 22, 1918.

quarter and satisfied myself that there was nothing else to do but to pass the Senate bill if we would avert trouble. To re-assure the House even more fully, if I can, I present this letter, sent to me by the President under date of April 21:

"THE WHITE HOUSE,
WASHINGTON, April 21, 1918.

HON. CARTER GLASS,
Washington, D. C.

MY DEAR MR. GLASS: I am taking the liberty of writing you to ask if the early report and passage of the silver bill will be possible. Circumstances have arisen which make the passage of this bill a genuine war emergency; otherwise I would not suggest so immediate action upon it. The circumstances, however, are pressing, and I beg you to believe, justify me in making this request. I believe that you have been informed from the Treasury Department just what the exigency is.

Cordially and sincerely yours,
WOODROW WILSON."

MR. HAYES. Mr. Speaker, under ordinary circumstances, I should be opposing this bill very strenuously on several grounds. If the country were not in this War, and the present emergency were not upon us, I should regard this bill as a piece of economic and financial folly. There are several things in it that, if it were in my power, I would change. I would amend it radically, but from the information that has been conveyed to the members of the committee by the President, the Secretary of the Treasury, and the Federal Reserve Board, some of which information has been stated already by the gentleman from Virginia (Mr. Glass), I conclude that this is not only an emergency measure but a matter of the greatest urgency. I therefore feel it to be my bounden duty to support it as it is, since under the rule just adopted, it cannot be amended.

MR. WOOD of Indiana. It comes to us rather suddenly here. I want to inquire if there is any evidence before your committee as to whether or not England knew of this exigency for some time, and considered it before this was sprung on the United States.

MR. HAYES. England has known for some time that she had out obligations, of course, but she was not familiar, and the world has not been made familiar, and is not now familiar, and it is not desirable that it should become familiar, with the dangers that lurk in the immediate future.

MR. WOOD of Indiana. Did England take any steps to relieve this situation?

MR. HAYES. Certainly; all the steps that were possible. As the gentleman from Virginia (Mr. Glass) has stated, the United States has the only great supply of silver that is in the world.

MR. WOOD of Indiana. I saw a statement in the paper this morning, and I think it would be fair that the gentlemen should know of it, to the effect that in this transaction there is a speculation of over $70,000,000 by bankers of England. Does the gentleman know anything about that?

MR. HAYES. I know nothing about that. I want to say that under ordinary circumstances I should insist upon acting upon my own judgment and experience, after many years of study of financial questions; but under the present circumstances, when the Commander-in-Chief of the Army and Navy of the United States comes to me and says, "The passage of this bill is a most vital war necessity," I sink my own judgment and my own feeling in the matter and yield to his urgent request as if it were a command. (Applause). Although the circumstances surrounding this emergency have been quite fully explained to the members of the committee, many other things are doubtless known to the President that he is not at liberty to explain to the members of the committee; necessarily information must be open to him that he could not disclose to us.

Metal Business of the A. S. & R. Co.

Metals and other products sold by this company during 1917 realized $427,189,915. Operating statistics are as follows:

	1915	1916	1917
Men employed, excluding Mexico	15,556	21,073	24,698
Wages and salaries, excluding Mexico	$11,392,503	$17,047,944	$24,497,836
Average wages per 8-hour day	$2.44	$2.70	$3.31
Charge smelted, tons	4,153,092	4,789,474	5,918,924
Bullion refined, tons	579,080	677,460	706,875
Coal used, tons	604,204	724,595	787,890
Coke used, tons	401,511	454,468	592,765
Fuel-oil used, barrels	829,304	1,107,285	1,560,535
Gas used, cubic feet	1,071,593,000	2,130,460,328	3,032,908,373
Ore mined, tons	1,578,611	1,638,566	2,318,925
Coal mined, tons	235,222	244,807	259,499
Coke produced, tons	120,660	140,961	186,107
Metal products:			
Gold, ounces	2,672,702	2,662,011	2,496,693
Silver, ounces	76,117,453	71,868,451	69,841,061
Platinum and palladium, ounces	693	868	1,597
Lead, tons	296,986	279,144	275,266
Copper, pounds	551,798,000	789,438,000	848,888,000
Copper, best selected, pounds	.....	.....	68,086,000
Spelter, pounds	36,154,000	47,807,547	52,522,000
Nickel, pounds	1,120,556	1,224,328	682,715
Tin, pounds	.....	4,522,000	12,130,000
Sulphuric acid, tons	17,062	12,921	33,087
Arsenic, pounds	7,269,000	9,090,000	9,132,000
Copper sulphate, pounds	8,366,000	13,046,000	7,598,000
By-product metals, pounds	2,229,887	5,671,827	5,131,709
Copper and brass manufactures, pounds	8,763,480	31,597,489	30,767,274
Test lead and litharge sold, lb.	355,229	417,898	426,472
Loaded cartridges sold, number	12,898,000	15,338,000	14,180,000
Sheet-lead, pipe, etc., sold, lb.	9,638,205	21,713,331	13,678,245
Mixed metals sold, pounds	2,566,255	2,831,617	6,188,045

POTASH is recoverable electrolytically by a patented method devised by E. L. Anderson. The source of potash in this case is feldspar. It is ground and mixed with carbon, and the mixture is electrolyzed in a solution of H_2SiF_6, producing KOH.

WASTAGE at the Philadelphia Mint in 1917 in coining 285,646,712 pieces of silver and copper domestic coin, and $11,075,110 pieces for Central and South America, was only $918. The metal handled amounted to 2007 tons.

SILVER production of the Kongsberg mines, Norway, during the last fiscal year amounted to 8072 kg., equal to 259,500 oz. The average price received was 93.81 crowns, or $25.14 per kg., giving a total of $202,855.



NEW YORK

A. I. M. E. Meeting: Taxation and New Cornelia Copper Mine.—Mexican Railways.—Platinum.

The April meeting of the New York Section of the A. I. M. E. was held at the Machinery Club on April 23, preceded by the usual informal dinner. The subject for discussion was the report recently compiled on mine taxation and price-fixing by a committee consisting of J. Parke Channing, C. F. Kelley, and J. V. N. Dorr. Unfortunately, interest in the matter appeared to be at a low ebb and there was no comment, a result attributable to some extent to the absence of the three gentlemen mentioned. The report merits wide attention, but appreciation of the work and discussion of the conclusions reached would have been facilitated if a summary could have been presented that would have enabled the average mining engineer to comprehend the issues at stake, without the loss of time involved in the examination of the legal intricacies of the question. After the passage of a formal vote of thanks, L. D. Ricketts gave an interesting account of mining and metallurgical operations at the Ajo (New Cornelia) copper mine in Arizona. Motion pictures were shown illustrating the normal life in the township which, during the past few years, has sprung into existence on the Arizona desert. Realistic representations of blasting gave members an idea of the scale on which such operations are being carried on, and the difficulties encountered in handling and reducing the enormous masses of rock freed by the explosion. Mechanical arrangements for the transport and reduction of the ore to leaching size (8-mesh), indicated a perfection of design and an elimination of unnecessary handling. Ore from the cars is first discharged into one No. 24 Allis-Chalmers gyratory-crusher where it is reduced to 6-in. size. This delivers to four No. 8 machines of the same type, which are hardly sufficient for the work. From here the crushed ore is delivered by belt-conveyor to steel storage-bins from whence it is fed to four 48-in. Symons horizontal disc-crushers, operating in closed-circuit with stationary screens and ultimately delivering a 3-mesh product. Particular interest was displayed in the pictures showing the method of filling the 500-ton leaching-vats by means of a belt-conveyor with an automatic tripper which delivers the material evenly across the width of the vat in successive diagonal layers. This ensures a desirable classification of the material, whereby the coarse particles roll to the bottom and form a protective layer, which minimizes the passage of fine through the perforations of the filter-bottom. This idea was apparently borrowed from Chuquicamata. The method of applying the solution was shown, Dr. Ricketts explaining that upward counter-current leaching is adopted. The success of this method at Ajo, and the small amount of trouble experienced with accumulations of slime underneath the filter-bottom would suggest a wider application of the idea to methods where leaching of coarsely-broken material is feasible, such as the Chilean nitrate industry. An electrically operated 14-ton Hullitt excavator is used for discharging the vats, the arrangement indicating the advantage of ample capacity as a factor in saving time. The pictures showing the handling of compressed iron scrap by means of lifting-magnets, the precipitating-launders, and the electrolytic department, gave a complete insight into the final operations, and were much appreciated. In response to an inquiry it was stated that the work had not been carried on long enough to make a definite statement as to metallurgical results, although the amount now recovered was nearing 80% of the copper content of the ore. In this connection, Dr. Ricketts made some pertinent remarks, which supported the contention that in wet-chemical methods of treatment, such as the one described, the extraction of the metal from the ore by means of a solvent is not to be confused with recovery; and that the calculation of percentage recovery is the basic factor on which considerations of ultimate success or failure can alone be gauged. In conclusion it was announced that this outpost of civilization was so awake to its national obligations that no less than 90% of the Americans and 20% of the Mexicans had subscribed to the third Liberty Loan.

At a meeting of shareholders of the National Railways of Mexico, held at Mexico City during the past week, Henry Bruére was among those elected to comprise the New York board of directors. He is the vice-president of the American Metal Co., who recently left here for Switzerland to arrange for the elimination of German control in the company's Mexican interests.

The extension of price-fixing to platinum, foreshadowed in a recent report from Washington that the metal would be commandeered at the fixed price of $100 per ounce, has not met with unanimous approval. Although the Government prohibited the sale of the metal by dealers or its manufacture into jewelry by craftsmen some time ago, the fact remains that no steps have been taken to relieve them of their stocks—a condition which must inevitably entail loss unless they evade the restrictions. A great deal of misapprehension has existed throughout the country with reference to the original order. Many people construed it to mean that it was illegal to have unworked platinum in their possession and promptly sent their supplies to Washington, only to find that the Government had no intention of buying. The tentative price of $100 per ounce now mentioned will discourage speculation in the metal and will offer no inducement to dealers who have the idea that the metal may be collected now and re-sold later to the Government at an enhanced price.

LAS VEGAS, NEVADA

Manganese Ore of the District.

The Manganese Association sold its lease, running about three years, to Los Angeles people for $87,500. From this, $16,000 debts of the Association will be paid. The deal also includes some additional claims, locations made by the Association, of ground adjoining the three original claims; also the contracts with Suffern & Co. of New York for delivery of 90,000 tons, within 10 months. Some ore, possibly 2000 tons, has already been delivered on this contract. There is a prior contract, of 1000 tons per month, to McCarthy. The ore is peculiar. It is light (probably 'bog' ore) 35 cu. ft. to a ton. It is quarried and is so soft that an ax is used to trim off waste. The steel companies cannot use it in blast-furnaces, as much as 80% goes up the

stacks. Makers of ferro-manganese in electric furnaces can use it. The ore, as shipped, averages 39% Mn, and 12% SO_2. It is a flat deposit, covering a considerable area, known to be several hundred feet square. Some drill-holes show 40 ft. thickness. Surface overburden, one to two feet thick, is plowed and scrapped off.

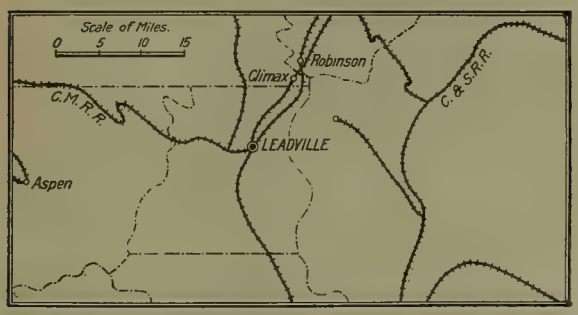
LEADVILLE, COLORADO

Mining and Dressing Molybdenite at Climax.

A big mining project is now under way at Climax at the boundary-line between Lake and Summit counties and about 16 miles north-east from Leadville on the Colorado & Southern narrow-gauge railroad running to Denver. At this point the Climax Molybdenum Co. has been active for eight months erecting mining and milling plants and developing its mine on Bartlett mountain, where the greatest molybdenite deposit now known to exist in North America is situated. The entire mountain, whose peak rises to a height of 13,000 ft., is said to be ore averaging 1% molybdenite—a statement that renders superfluous an estimate of reserves.

The lode-rock is quartz-porphyry and decomposed granite thickly foliated with molybdenite with a little iron pyrite.

A large and modern plant is now in operation. At present



MAP SHOWING SITUATION OF CLIMAX, COLORADO, AN IMPORTANT MOLYBDENITE DISTRICT.

all mining is being done through the upper tunnel on the south-western slope of Bartlett mountain overlooking Ten Mile creek from an elevation of 12,107 ft. This adit, running north-east, penetrates the mountain for a distance of 830 ft.; and, with the exception of a few feet near the breast, it is all in ore. Just inside the portal, two cross-cuts are driven at right angles and advance 400 ft. either way to the side-lines of the company's ground. Here they swing around in rough half-circles and return to the main adit at a point 750 ft. from the portal. These cross-cuts surround two solid blocks of ore 750 ft. long, 400 ft. wide, and approximately 370 ft. high, measuring 222,000,000 cubic feet. Ten cubic feet of ore equal a ton. The orebody is being stoped along the entire 800-ft. face extending on either side of the main adit. Chutes are being placed at intervals of 25 ft. with intervening pillars 50 ft. high between them. The first stope is now being carried up from these pillars on a width of 25 ft. and will be continued right through to surface. When finished, it will contain 740,000 tons of broken ore. It is planned to take 30 similar slices off the orebody.

The lower adit is 200 ft. lower down the mountain; it is 170 ft. long and 10 by 12 ft. in the clear. It is being equipped with heavy double-track and when it has reached its full length of 2200 ft. it will be fitted with an electric haulage system. This adit will be the main artery of the mine. At the present rate of development, 300 tons of ore is being extracted daily. Production will be increased to 1000 tons daily during the summer.

A Leschen tramway 4700 ft. long connects the mine with the mill at Climax. The mill is the largest of its kind now operating in the United States. When it was erected last winter, it was stated to have a capacity of 250 tons daily, but in actual operation it handles 350 tons. The process used is a form of flotation. The ore is ground in ball-mills with oil and chemicals to 60-mesh. It is then put through a Dorr classifier, the oversize being carried off to another ball-mill for re-grinding. The fine is pumped into a series of Janney flotation machines, four 'roughers' and one 'dresser,' which catches the froth from the others. These machines are expected to remove the iron content. From the Janney machines the froth is pumped into a Callow machine, the concentrate from this box going to a second Callow for final separation. The finished product is pumped into two large settling-tanks, drained by a Portland filter, and sacked. The tailing from the No. 2 Callow is returned to the ball-mill with the oversize from the classifier.

The concentrate now being made averages 70% molybdenite and a small percentage of iron. At present it is worth $2 per pound. To secure 1 ton of concentrate the mill must handle 130 tons of crude ore.

The erection and operation of the plant has been in charge of John H. White, as manager. He is assisted by James R. Welsh, mine superintendent; A. Ira Renick, mill superintendent; and G. O. Anderson, superintendent of construction.

With a shipment of 25 tons of molybdenite concentrate sent out on April 19, and another of 25 tons on the 30th, the Climax Molybdenum Co. had gross earnings last month amounting to $304,000. The product was delivered to the Government at Pittsburgh, where it realizes $2 per pound. The company has now produced 76 tons of concentrate. The manager reports that the mill is doing much better work. The first concentrate carried from 65 to 86% MoS_2; the second between 70 and 93%; the third was till higher, and it is believed that a 90% average concentrate will be produced in time.

The Molybdenum Products Co., which has erected its mill at Buffehr, a mile below Climax, to the north-west, is ready to begin operations. The company has developed a large deposit just east of the property controlled by the Climax Molybdenum Co., on Bartlett mountain. The ore is similar to that being extracted by the Climax people, carrying an average of 1% MoS_2. The mine is 1½ miles from the mill, the two being connected by a Leschen aerial tram. The mill has a capacity of 250 tons, and will be enlarged as operations continue. The company has erected a substantial and modern plant. An 80% product is expected.

Suits involving the title to large areas of ground in the Climax field, which are to be heard before the State Supreme Court in June, have held up work of the Pingrey Mines Co., the third big operator that has entered the molybdenite area. The company had completed plans for erection of the largest mill that has been put up in this field, and contemplated starting construction early in May. Considerable development has been done in several claims, where an immense tonnage has been opened. These plans were set aside temporarily until the legal tangle to some of the ground has been defined. The suit between Lake and Summit counties over the boundary line, a proceeding that makes uncertain the position of the Climax field with regard to county possession, has also aided in causing the company to abandon its plans.

HELENA, MONTANA

Labor Troubles Closing Mines.

Owing to a strike of stationary engine-men in the Helena district, four companies have ceased mining ore and are barely able to keep the mines from flooding. The men demanded an increase of $1 per day, over that formerly paid, which was at the rate of $4.50 per day. The raise was not

granted, but the demand had the effect of creating a desire on the part of miners to ask also for an increase over the present $4 rate. One good gold producer, which has paid $200,000 in dividends, has been closed indefinitely. This is the Thomas Cruse Developing Co.'s property in Scratch Gravel hills. It is developed on the incline to 640 ft., and laterally 1500 ft. It adjoins the Scratch Gravel Gold Co.'s holdings, which have been abandoned. Both mines are now filling with water, and nothing is said regarding the future of these two companies.

DULUTH, MINNESOTA

Early Operations on Mesabi Range.

Stripping is to start immediately at the Mace mine, between Keewatin and Stevenson, and it is planned to have a large force at work this summer. Butler brothers have the contract for stripping, and are now engaged in building camps near the site, and making necessary roads to aid in moving ground with all possible speed. It is not proposed to work the Mace as an open-pit mine, but stripping is for the purpose of opening a 'milling' pit east of the present shaft. Ore will be broken down in the pit and trammed to the shaft now in use. The Mace has never been a large producer, and there is not much of ore left in the mine, so it has a limited future.

A cave-in occurred recently at the Butler brothers stripping works. This caused some delay, but no men or machines were caught. Tracks for the waste-cars that were hauling from the big shovel are near the edge of the pit, resulting in the necessity of changing the tracks. Considerable time will be lost in doing this.

The Mississippi is the first mine in St. Louis county to start loading cars for the season of 1918. The cars are being loaded with ore that caved in the drifts and tramways during the time the mine has been idle. It will be stored at the docks at the head of the lake till navigation commences. It is not planned to stockpile any ore at this mine this spring, but to load all ore hoisted directly into cars. A large force will be put on immediately.

Work on the new 100-ft. concrete chimney at the Mississippi mine is about done. The last of the concrete was put on three weeks ago. The brick lining, which extends up for 30 ft., has been laid. It was expected that full power would be available soon. This would allow for the use of underground electric haulage, materially speeding-up work in the mine. Ore that is being removed from underground workings as clean-up work progresses is being loaded into cars. A large number are ready to ship to the docks. This mine will be one of the big producers among underground properties this season.

COBALT, ONTARIO

General News, and the Fort Matachewan gold district.

Lateral work has been resumed on the 1600-ft. level of the Temiskaming mine. This horizon has been recommended for exploration by Alfred R. Whitman, a leading geologist of this district.

The National Mines (formerly the King Edward) has resumed work, the 80-ton flotation plant being started a week ago. Results are fairly satisfactory.

The McKinley-Darragh-Savage has decided to resume work on the Savage section of its property, where there are from 10 to 12 acres of conglomerate formation as yet unexplored, and considered to have fair possibilities.

The Mining Corporation of Canada has made a second cash payment on a group of claims in the township of Rickard, on which encouraging deposits of gold-bearing quartz are being developed. This concern is maintaining its record in silver production, being ahead of any other silver mine under the British flag.

Elk Lake.—A fair rush of prospectors is taking place to the Fort Matachewan district, where encouraging discoveries of gold have been found in large sulphide dikes. Small mining equipments are being taken in for some properties.

PORCUPINE, ONTARIO

McIntyre and Newray.—Davidson and Ankerite.—Kirkland Lake Notes.

Porcupine.—The McIntyre company has acquired a controlling interest in the Newray mine, having taken an option on 51% of Newray shares at 45c. each. The McIntyre is to have a free hand in development and may either continue operations at the 400-ft. level, where an important development was recently made, or begin somewhere else. The Hansen vein in the Newray has been opened for 140 ft. on the 400-ft. level, assaying $10 per ton. As the McIntyre is thoroughly acquainted with the mineralized zone traversing its properties, continuing into the Newray, the prospects for development of the latter into an important producer seem favorable.

The new 10-stamp mill at the Davidson is operating well. A high-grade orebody, 19 in. wide, was cut on the 100-ft. level. The main shoot has been opened for a length of 200 ft. Cross-cutting shows a considerable width of milling ore.

Arrangements have been made by which the Dome Lake mill of 200-ton capacity will test 1000 tons of ore from the West Dome mine. This may be preliminary to a permanent agreement for the treatment of the West Dome output.

At the Ankerite, being developed by the Coniagas company of Cobalt, a 12-ft. vein, stated to assay $20 per ton, has been cut on the 275-ft. level.

Kirkland Lake.—The Wright-Hargraves has overcome successfully some trouble with water. A station has been cut on the 300-ft. level, where the width and grade of the ore is well maintained. The shaft is being sunk.

The new 60-ton mill of the Lake Shore is giving good results. Ore averages $23 per ton.

At the Elliott-Kirkland, the rich ore opened at 425 ft. has been driven on for 100 ft., the vein maintaining its grade.

The Burnside shows rich ore at the 100-ft. level, where there is a 12-in. vein carrying over $127 per ton, with low-grade ore on the wall.

Annual report of Tough-Oakes shows a net deficit of $79,062. Total earnings were $340,086, operating costs, $364,847; and general expenses, $54,300. Total deficit at the end of the year was $198,290.

Mill of the Teck-Hughes during February worked 88.7% of the possible time, treating 2374 tons of ore, averaging $7.27 per ton.

BAKERSFIELD, CALIFORNIA

Independent Oil Producers Meet.—Rise in Price of Oil.

On May 1 the Independent Oil Producers Agency, representing 175 petroleum companies, met here and was addressed concerning the situation by T. A. O'Donnell of the U. S. Fuel Administration. The annual report of the company for 1917 shows that 17,442,852 bbl. of oil was sold at an average of $1.08¼ per barrel. The average price was much higher than in 1916, due to a new contract with the Union Oil Co. The year ended with a balance of $117,796, against $73,326 at the beginning. Oil stocks were 11,683,613 bbl. on January 1, 1918, a decrease of 429,772 barrels.

The Standard Oil Co. announces an advance of 25c. per barrel for crude oil at the well. The new schedule, effective May 1, ranges from $1.23 for 14-gravity oil to $1.57 for 37° and over. The previous range was from 98c. to $1.32 per barrel. This rise was reflected in a general advance in the price of oil shares last week.



ARIZONA

Chloride.—The Schuylkill Mining Co. recently made final payment for the Tennessee mine. A mill is to be erected soon to dress all ore from the Tennessee and Schuylkill.

Kingman.—The Banner Gold Mining & Milling Co. is now putting in a compressor and other equipment. Contracts have been let for 350 ft. of development. Value of the ore increased in ground being opened on the 400-ft. level.

Mayer.—The Pocahontas mine is being re-opened. The present shaft will be sunk to the 500-ft. level and a mill erected to treat ore on the dump, taken from old workings.

Oatman.—The Gold Ore company is now treating 40 tons of ore daily at the Gold Road mill. Both compaines are to treat ore in the same plant. The owners are erecting a crusher and Marcy mill at the mine. A pipe is to carry the coarse-ground ore to the mill, where tube-mills will reduce it further for cyanidation by the C. C. D. system.

The United Eastern output for March was 7980 tons valued at $156,065, or $19.56 per ton.

The Bald Eagle workings of the Tom Reed company are now connected with the Gray Eagle. The Bald Eagle orebody is to be explored by cross-cuts every 50 ft. Development will be continued in the eastern part of the Bald Eagle claim, where a cross-cut is being advanced to find the vein north of the fault. In order to mill the high-grade ore from the Bald Eagle changes are being made in the cyanide plant.

Pearce.—The Central Butte Mining Co. has just purchased a Chicago Pneumatic Co.'s oil-engine driven air-compressor to be erected on its property four miles south of this place. Development has shown a large body of low-grade copper ore.

Prescott.—Preliminary operations by the New United Verde Copper Co. at the old Logan mine have been so favorable that extensive development is planned.

The Arizona-Virginia Copper Co. has purchased 15 claims in the Castle Creek district from P. A. Johns of this city. Considerable high-grade ore had been mined by previous owners and Mr. Johns continued development, shipping several carloads. The new company is controlled by Colorado and California capital, and E. C. King, former superintendent of the smelter at Humboldt, is in charge. The property has been opened by three adits, approximately 500 ft. There is also a 200-ft. incline shaft and some stoping, making a total of about 900 ft. of work. Smelter records show that the 269 tons averaged 15% copper and $1.50 silver, netting $55 per ton after deducting all charges.

Superior.—The Magma Chief Copper Co.'s Watson tunnel is in 1900 ft., with 200 ft. to go. From the end a drill will bore 600 ft. farther, equal to a depth of 1300 ft. The tunnel recently passed through silver-bearing manganese.

Tombstone.—Phelps-Dodge Corporation is sinking a shaft at the Bunker Hill to determine the extent of the manganese orebody. A plant will be erected at Douglas to test this ore.

Tucson.—The Pima Mining & Smelting Co. has completed payments on the smelter at Socorro, New Mexico, and will move the plant to Tucson. A mine has been bonded in the Dos Cabazos district, while another is to be secured. These are expected to ensure a supply of ore.

Molybdenum mines in this district are suspending work on account of market conditions.

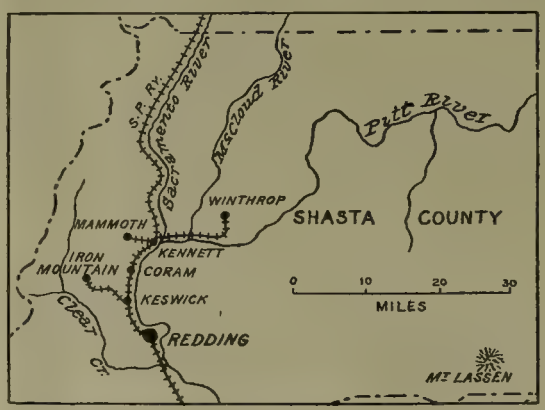
CALIFORNIA

On May 7 the Industrial Accident Commission held a public hearing to consider amended tentative safety rules for gold dredges. These were prepared by the following: Harold Mestre (chairman), consulting engineer; F. L. Lowell (secretary), deputy mine inspector for Commission; L. D. Hopfield, of Natomas company; C. W. Gardner, of Hammon Engineering Co.; A. L. Wilde, of the International Brotherhood of Steam Shovel and Dredgemen; Carl Brown, of California Casualty Indemnity Exchange; R. L. Eltringham, electrical engineer for Commission; H. M. Wolfiin, mining engineer U. S. Bureau of Mines, chief mine inspector for Commission.

Carrville.—The boarding-house, warehouse, store, stock and fixtures, and six cottages at the asbestos mines on the south fork of Trinity river have been burned. The mines, owned by the Trinity Asbestos Mining Co., have lain idle for two years.

Ingot.—Five or six auto-trucks are hauling zinc and copper concentrates from the Afterthough flotation plant to the railroad at Bella Vista, 16 miles distant. One thousand tons was on hand when the roads opened after the rains.

Redding.—Material is arriving for construction of the



MAP SHOWING PRINCIPAL CENTRES OF SHASTA COUNTY, CALIFORNIA.

American Gold Dredging Co.'s boat across the river from Redding. The wooden hull will be 44 by 122 ft. Buckets are of 6 cu. ft. capacity. The wooden spud is 36 by 24 in. and 50 ft. long. The boat will be completed in 90 days after construction begins.

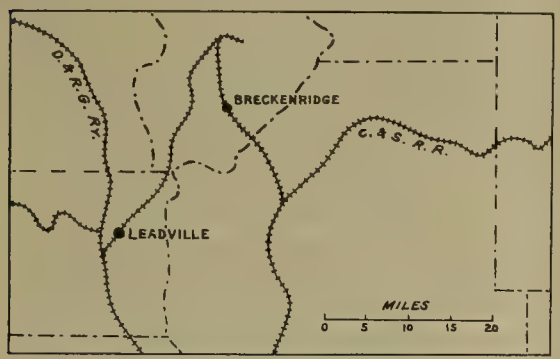
Winthrop.—The A. S. & R. Co., new owners of the Bully Hill mine, is making extensive improvements. The old smelter is being changed to a flotation plant. The first unit, for which machinery is on the ground, will have a daily capacity of 150 tons. The completed plant will have double

that capacity. A lodging and boarding-house, to accommodate 100 men, are being erected, also a club-room. Sixty men are employed in the mines; more are required. Daily shipments of ore to the smelter at Kennett are 115 tons.

COLORADO

Boulder.—Tungsten producers of this district met here last week to arrange for representatives to go to Washington to discuss price-fixing of tungsten and other minerals. About $30 per unit is recommended for tungsten, which would increase production by a third.

Breckenridge.—Dredging has been started for the season. The French Gulch Dredging Co. was the first to begin. It is digging ground 38 to 45 ft. deep.——The Powder River Gold Dredging Co.'s new boat in Blue River valley is ready,



MAP SHOWING SITUATION OF BRECKENRIDGE, COLORADO.

only awaiting repairs to power line. Buckets are of 8-cu. ft. capacity.——The Tonopah Placers Co.'s three boats will soon resume. Gold recovered by dredging this year should be $1,000,000, a gain of $150,000 over the 1917 total.

Cripple Creek.—Gold production of the district in April totaled 104,500 tons, averaging $9.59 per ton. Some of the milling records are as follows:

Mill	Tons	Value
Golden Cycle (Colorado Springs)	29,500	$21.00
Portland (Colorado Springs)	6,000	20.00
Portland (Cripple Creek)	38,800	2.04
Portland (Cripple Creek)	7,900	2.30
Vindicator (Cripple Creek)	20,000	1.96
Smelters	2,300	55.00

Eureka.—At the Sunnyside mine the U. S. S. R. & M. E. Co. is busy. For employees a bunk-house and club-room are being erected. The 16,000-ft. Trenton aerial tram is finished. At one point the cables are 500 ft. above ground. Storage-bins at the new mill will hold 3000 tons of the lead-silver-gold-copper ore. Marcy ball-mills crush the ore.

West Cliff.—The well-known Bull Domingo mine is again in commission. When silver was 50c. per ounce and lead 3.50c. per pound this mine produced $1,500,000, mined from a depth of 1000 ft. In the same district are the Bassick and Geyser, two great producers of long ago. The former is opened to 1500 ft., the latter to 2800 ft., the greatest depth of any mine in Colorado. Ore carries silver, lead, and zinc. There are three large dumps estimated to contain 300,000 tons, which will be milled and are estimated to yield $10 per ton, two tons concentrated into one. Besides the zinc orebody 30 ft. thick at the 550-ft. level there is a good quantity of lead, silver, and gold ore in the mine. The Bull Domingo has equipment capable of working to a depth of 3000 ft. The plant was formerly on the Geyser and is complete. Louis Wagner, well known in Colorado, financed the taking over by the Bull Domingo Development & Mining Co. and is general manager.

IDAHO

According to Robert N. Bell, State Mine Inspector, labor situation seems to be the only handicap in Idaho. All mines appear to be running shorthanded. New development is suffering in consequence, and all operations are being confined largely to ore production.

Kellogg.—The Bunker Hill & Sullivan smelter here is turning out 120 tons of refined lead daily and is working well.

The Douglas mine of the Anaconda company of Montana, on Pine creek, has resumed shipments of zinc ore after being closed during winter. There is said to be considerable ore blocked out and broken.

The Constitution lead-zinc mine near the Douglas is in good condition for production when the new railway is finished.

Sagle.—Preparations for mill construction are soon to be started at the Armstead mine on Pend Oreille lake. The initial unit will be of 100 tons capacity.

KANSAS

Treece.—A 40-acre lease and developed mine near here has been sold by Playter brothers of Joplin, Missouri, to A. M. Brennan and others of Oklahoma City, Oklahoma, for $150,000. A 400-ton mill is to be erected.

MICHIGAN

Houghton.—Franklin Mining Co. in 1917 had an income of $1,048,303, of which $792,527 was from copper sold. All charges totaled $762,106. Surplus at beginning of year was $192,094, and at end $286,198. The superintendent, Enoch Henderson, reported that new openings covered 1916 ft., driving 1603 ft., costing $6.998 per foot. Work north of the amygdaloid indicates ore of better grade with depth in that direction, and a large tonnage of better than average (10.3 lb. per ton) grade has been opened on No. 30 level north. On the conglomerate the best ore seems to be in the south. Ore stamped was 303,625 tons, yielding 3,155,574 lb. copper, and sold for 26.74c. per pound.

MISSOURI

Joplin.—Production of the Missouri-Kansas-Oklahoma region last week was 6406 tons blende, 45 tons calamine, and 1173 tons lead, averaging $42, $30, and $80 per ton, respectively. Total value was $368,206, making $8,070,434 for 17 weeks. Oklahoma contributed ore worth $258,454, and Kansas $48,385.

The Tri-State Safety and Sanitation Association of Picher, Oklahoma, is endeavoring to ascertain whether or not the majority of zinc-ore producers of the Missouri-Kansas-Oklahoma region favor a selling organization of national scope.

MONTANA

Butte.—The Philadelphia shaft of Anaconda's Nettie mine is being deepened from 600 to 800 ft. This will help drain the Davis-Daly company's Hibernia mine.

Iron Mountain.—Intermountain Copper Co. has shipped 14 cars of concentrate valued at $2200 per car. Developments at 400 ft. are good. Fifty men are employed. The mill works three shifts.

Troy.—Zinc concentrate, carrying 30 to 36% metal, is being shipped regularly by Snowstorm Mines Consolidated, from mill and accumulations. Ore sent to the mill—up to 300 tons daily—is receiving closer sorting. No. 7 tunnel, to open the vein worked on the other levels, is in 700 feet.

Arguments were made at Missoula recently in the case of Edward McCaffrey, of Spokane, against Harry L. Day, brought to have a contract rescinded for the purchase of the Big Eight mine by Mr. Day. This mine is near the Snowstorm. About 2000 ft. of work has been done, showing zinc-

lead ore. The deposit was discovered many years ago by eight men, from whose number and stature its name was derived.

NEVADA

Las Vegas.—It is reported that Thomas Thorkildsen of Los Angeles has purchased the interests of the Manganese Association for $100,000 cash. The deposits are 16 miles south-east of Las Vegas, and were leased from B. R. Jefferson, R. N. Edwards, R. W. Martin, W. E. Ferron, and J. F. Marrs to James McCoy, J. O. Gillice, and W. H. Connor.

Midas.—Elko Prince company has paid 5c. per share, equal to $50,000. This is No. 3 dividend.

Mina.—A 100-ton concentrating plant will probably be built at the Gunmetal tungsten mine, 23 miles east of this place. Deposits consist of a large low-grade body, also an 18-in. vein of high grade. Fritz Elges and others are financing the work.

Palisade.—Union Mines Co., south of this place, has opened a large quantity of ore on its 700-ft. level. As soon as conditions permit a large mill is to be erected. Shipments are being made to smelters in Utah. Senator Thatcher is manager.

Virginia City.—Union Consolidated from November to March, inclusive, mined 8054 tons of $26.56 ore, also 1988 tons averaging $9.25 per ton. Returns totaled $230,000, of which $60,000 was paid in six dividends and $40,000 of debts.

From the 2300-ft. level of the Mexican, 42 tons of $28 ore was milled last week.

OKLAHOMA

Picher.—The Eagle-Picher Lead Co. started operations in this field on March 15, 1916. At present it has some of the best mines in Oklahoma, and 8 modern mills at work. In the Netta mill flotation is employed with jigs and tables. A. E. Bendelari is general manager.

OREGON

Medford.—The Blue Ledge copper mines, which suspended shipments late last winter, will resume. It is probable that 40 motor-trucks will be engaged in carrying 300 tons of ore each day from the mine to railroad this summer. Seventy-five miners have been employed all winter opening ore for these increased shipments. The Copper King, Bloomfield, and other groups being operated from the Blue Ledge district will also be heavy shippers.

Perry.—Extensive deposits of chrome near here, in Union county, have been acquired by A. L. White, W. J. Nicholls, and other Spokane men. A concentrator with a daily capacity of 75 tons is being built. It is expected to be ready within 60 days.

UTAH

Alta.—Samples taken from the lowest point in workings below third level of the Emma mine assayed 186 oz. silver and 58% lead.

South Hecla Mining Co. reports that during 1917 there was 1309 ft. of development performed, costing $13,234. Total openings amount to 27,846 ft. Work last year was mostly to the Wedge vein, from 250 and 400-ft. levels. Production was as under:

	Company	Lessees
Ore, tons	3,797	727
Gold, ounces	128	37
Silver, ounces	65,268	11,516
Lead, pounds	607,794	104,102
Copper, pounds	21,035	8,023
Zinc, pounds	361,964	85,682
Net profit	$27,788	.....
Net profit from lessees	3,019	.....

Property is well equipped. Efforts last year were mainly devoted to extracting smelting ore. Milling ore is to be exploited in 1918.

Gold Hill.—Western Utah Copper Co. is opening good ore on its 400-ft. level. Daily shipments are from one to two cars. More miners are being employed.

Recent developments in the Frankie mine of the Woodman company have been good. Above the adit there is 8 ft. of 5 to 8% copper ore.

The Undine mine has shipped some 10% copper ore, carrying gold and silver. In the past this property was a good producer.

Garrison Monster is to erect a compressor, hoist, and use drills. Shipments carry from 10 to 15% copper. Some lead-silver ore is also being mined.

Lessees at the Union claim sent 7 to 10% ore to smelters.

Goldstrike.—There is said to be considerable work under way in this district, principally on the original claim, the Hamburg of the Bull Valley Gold Co. Lessees are driving an adit, also sacking some ore. Other properties are the B. & B., Goldstrike-Virginia, Banker, and Goldbug.

Park City.—The Ontario Silver Co. is to sink on ore from 1700 to 2000 ft. This will be a winze 700 ft. from the shaft. The company's financial position is good.

Tintic.—On May 27, five companies owning 500 acres in the south part of the district are to discuss consolidation. It is proposed to merge the Diamond Con., Southern Queen Gold, West Morning Glory, and Homestake into the Laclede Mining Co. On the Laclede a shaft is down 500 feet.

Centennial-Eureka has opened 35% lead, 100 oz. silver, and $10 gold ore on its 1900-ft. level.

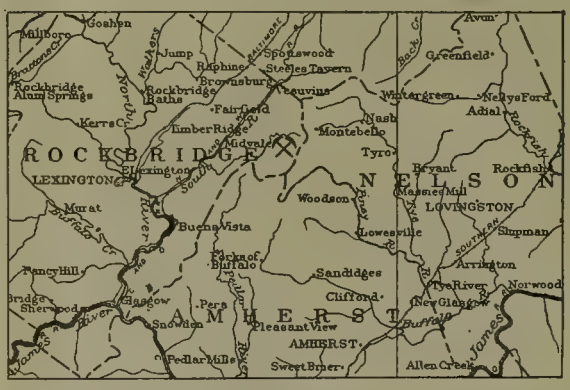
The Gold Chain mine at Eureka has been re-opened after a short shut-down due to labor conditions.

The Copper Leaf company is sinking below the 500-ft. level.

The Mammoth mine has been closed, as the men refused to work unless paid twice a month.

VIRGINIA

Montebello.—Tin deposits near Irish Creek, Rockbridge county, are described by H. G. Ferguson in Bulletin No. XV-A of the Virginia Geological Survey, at Charlottesville. The district is in an isolated part of the Blue Ridge district,



PART OF VIRGINIA, SHOWING SITUATION OF TIN DEPOSITS ON IRISH CREEK.

irregular hills and ridges, altitudes from 2000 to 3500 ft. Cassiterite was identified here in 1846. Some work was done in 1883 to 1885 by two companies. About 290 tons of 3.3% tin ore was mined but not shipped. In 1889, Boston people obtained an option and built a mill costing $50,000. About 2400 lb. of 48% concentrate was shipped. Litigation stopped work from 1893 to 1918, the title being un-

certain. Cassiterite is found in quartz veins that cut the hypersthene grano-diorite and in the adjacent altered grano-diorite. Deposits also contain arseno-pyrite, pyrite, siderite, wolframite, scheelite, muscovite, fluorite, and beryl. The arseno-pyrite is said to carry considerable gold and silver. Cassiterite assays 63.583% metallic tin. The veins are probably not continuous for long distances, but this is uncertain owing to lack of development. It is concluded that the district offers some hope of reward for systematic exploration of the discovered veins, and possibly other deposits may be found on the area of hypersthene grano-diorite. Presence of a greisen-like alteration product of grano-diorite is the best indication of tin, and everywhere appears to accompany the tin-bearing veins.

WASHINGTON

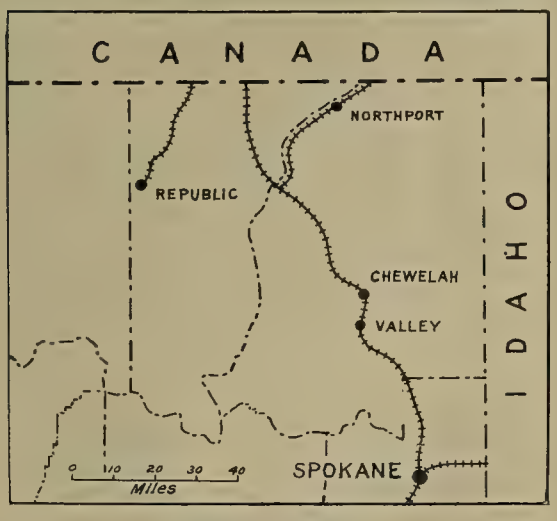
Chewelah.—The United Copper Mining Co.'s mill is now dressing 500 tons of ore daily. On 1300-ft. level the ore-body is 15 ft. wide, carrying 2½% copper and 8 oz. silver per ton. This is over a length of 240 ft. Eighty men are employed, but there is room for forty more.

Laurier.—Chrome has been found just across the border from here in British Columbia by Cameron, Myers, and others of Laurier. The Laurier copper mine is 5 miles south-west of this place.

Loon Lake.—This copper district is reported to show increased activity. Development has been confined to four properties. The Loon Lake Copper Co. has opened ore to depth of 500 ft., shipped considerably, paid dividends, and is to erect a 100-ton mill. This company has issued bonds for $40,000 for new plant. Judge George Turner of Spokane is president. The Jumbo shaft is down 100 ft. The Loon Lake Bluebird Co. is sinking to 200 ft., and plans extensive work.——The Spokane Copper Co. is sinking and is to erect larger machinery.

Northport.—The Electric Point company has proved the downward extension of an ore-chimney to the 700-ft. level. The ore is still a lead carbonate, but a change to the sulphide is expected at water-level. The 2¼-mile aerial tram will soon be erected.

Valley.—The Valley Magnesite Co. has contracted for



MAGNESITE DEPOSITS IN WASHINGTON ARE NEAR CHEWELAH AND VALLEY.

delivery of 2000 tons of calcined magnesite per month until the end of the War and for not less than a year. The plant is to be improved to the extent of $200,000 during 1918.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

L. D. Ricketts was at Ajo this week.

Albert Burch has returned to San Francisco from Cuba.

A. Doyle is in the 27th Engineers at Camp Meade, Maryland.

Howard D. Smith has returned to San Francisco from Nevada.

Karl Eilers has been in San Francisco on a tour of inspection.

Robert E. Kinzie has returned from a journey of inspection in Nevada.

Walter Harvey Weed is in San Francisco on his way from Arizona to Montana.

Benjamin Rezas has left the Colorado Mining Co., P. I., and will go to Burma.

William C. Madge has arrived at Seattle, on his return from Siberia to Butte.

Thomas F. Cole is at Los Angeles, on his way to Butte, after a visit to Ajo, Arizona.

J. M. Callow has been here on his way to Salt Lake City after a tour in the South-West.

Ernest Hibbert of Nickelton, Ontario, was in San Francisco, on his way to Miami, Arizona.

Edwin E. Chase and his son, **R. L. Chase**, have gone to Baker City, Oregon, to examine a gold mine.

Scott Turner has received a commission as Lieutenant (senior grade) in the line, U. S. Naval Reserve Force.

Sidney J. Jennings was here this week, on a visit to the properties of the U. S. Smelting, Refining & Mining Co.

J. H. Mackenzie has gone to Washington to give his services to the Bureau of Mines in mobilizing the tungsten output.

A. J. McGregor, of South Porcupine, Ontario, is on his way to Nicaragua, as surveyor and assayer for the Chontales Mines, Ltd.

Harry Franklin, engineer for the Las Quebradas Mining Co. of Central America, is in San Francisco this week on his way to New York.

H. D. Staley, Pacific Coast representative of Halcomb & Davidson, Inc., makers of mine drill and tool-steel, is in New York for three weeks.

Edgar A. Collins, superintendent of the Ridder mine, in the Altai, has returned safely with his family from Siberia, and is now at Ben Lomond, California.

Samuel Cohen has resigned from the management of the Crown-Reserve company at Cobalt, Ontario. He is succeeded by **Harry Stewart**, formerly assistant manager.

Charles R. Keyes, consulting engineer, of Des Moines, has been chosen by the Democratic party of Iowa as candidate for the United States Senate, to succeed Senator **W. S. Kenyon**, whose term soon expires.

C. M. Eye, superintendent for Benguet Con. Mining Co. at Baguio, P. I., is spending his vacation in China and Chosen, with headquarters at Shanghai, in care of the American Consulate. He expects to return to the Philippine Islands by July 1.

J. Parke Channing, chairman of the Engineering Council, has appointed the following Committee on Patents: **Charles A. Perry** (chairman), **C. A. P. Turner, Corydon T. Purdy, Horace V. Winchell, Edwin J. Prindle, David S. Jacobus, Frank N. Waterman**, and **J. Parke Channing**. This committee will investigate reforms in the United States patent system and in the use of experts in litigation, co-operating with similar committees of the National Research Council and the technical societies.

THE METAL MARKET



METAL PRICES

San Francisco, May 7

Aluminum-dust, large and small lots, cents per lb	65—70
Antimony (wholesale) cents per pound	13¼
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7¼— 8¼
Platinum, pure and with 10% iridium, per ounce	$108—$116
Quicksilver, per flask of 75 lb	$110
Spelter, cents per pound	9¼
Zinc-dust, cents per pound	17½

ORE PRICES

May 7

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38% and over, California, per unit	$1.25—$1.50
Manganese, 40 to 50% Mn, Hazen, Nevada, cents per unit	92—110
Manganese, 48%, New York, per unit	$1.20
Tungsten, 60% WO_3, California, per unit	$24
Molybdenite, per lb., 85% MoS_2	$1.80

EASTERN METAL MARKET

(By wire from New York)

May 7.—Copper is unchanged. Lead is quiet but steady. Spelter is firm and higher.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67c. for small lots, effective until June 1, 1918. Quotations in cents per pound are as under:

Date		Average week ending	
May	1	Mch. 26	23.50
"	2	Apr. 2	23.50
"	3	" 9	23.50
"	4	" 16	23.50
"	5 Sunday	" 23	23.50
"	6	" 30	23.50
"	7	May 7	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	23.50	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to get prompt settlements, apparently with smelters and others, sellers allow a discount from the Government price of $1, hence the lower price.

Date	New York, cents	London, pence	Average week ending	
May	1	99.62	49.25	Mch. 26	91.27
"	2	99.50	49.12	Apr. 2	92.12
"	3	99.50	49.12	" 9	91.74
"	4	99.50	49.12	" 16	93.73
"	5 Sunday			" 23	97.35
"	6	99.50	49.12	" 30	99.66
"	7	99.50	49.12	May 7	99.52

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

Melting of silver dollars commenced at the New York Assay Office on April 26. Its daily capacity is up to 600,000 dollars, equal to 515,210 ounces of silver, plus the copper alloy in the coin.

Discussing the future of silver, the 'Boston News Bureau' considers the price stabilized but not fixed at $1 per ounce. While the Pittman silver bill is popularly supposed to fix the price at $1, the question has been raised whether this is not a minimum, and that no limits have been placed on a maximum price. The law as passed does not commandeer the output of silver, neither is there anything in the law or any agreement between the silver producers and the Government that the mining companies shall sell to domestic consumers at the same price as to the Government. In this respect the silver situation is different from steel and copper. Officials of silver-producing companies say that no agreement has been made whereby their entire output or any specific proportion of their output is to be turned over to the Government. The Pittman bill enables the Government almost immediately to come into possession of 350,000,000 silver dollars, and while these may be melted and exported as fast as silver certificates can be withdrawn, and the dollars so melted are to be replaced, there is no time limit placed on the re-coinage.

Following is the text of the purchasing section of the Pittman Silver Bill (S. 4292) as it passed Congress:

Section 2. That upon every such sale of bullion from time to time the Secretary of the Treasury shall immediately direct the Director of the Mint to purchase an amount of silver equal to 371.25 grains of pure silver in respect of every standard silver dollar so melted or broken up and sold as bullion. Such purchases shall be made in accordance with the then existing regulations of the Mint and the fixed price of $1 per oz. of silver 1000 fine, delivered at the option of the Director of the Mint at New York, Philadelphia, Denver, or San Francisco. Such silver so purchased may be re-sold for any of the purposes hereinafter specified in Section 3 of this Act, under rules and regulations established by the Secretary of the Treasury, and any excess of such silver so purchased over and above the requirements for such purposes shall be coined into standard silver dollars or held for the purpose of such coinage. The net amount of silver so purchased, after making allowance for all re-sales, shall not exceed at any one time the amount needed to coin an aggregate number of standard silver dollars theretofore melted or broken up and sold as bullion under the provisions of this Act, but such purchases of silver shall continue until the net amount of silver so purchased, after making allowance for all re-sales, shall be sufficient to coin therefrom an aggregate number of standard silver dollars equal to the aggregate number of standard silver dollars theretofore so melted or broken up and sold for bullion.

Commenting on the silver situation as at April 11, Samuel Montagu & Co. of London say that the drawing rates of the Indian Council have been advanced one penny (two cents) as a consequence of the Silver Bill passing Congress. If the Indian government is in a position to secure a large proportion of the United States government silver, it will be placed in a very strong position as to the currency problem. Unless the British government has arranged with the American government for these silver transactions, a rate of exchange differing from that which has obtained during the last two years, the cost of the silver content of the rupees purchased at $1 per ounce 999 fine (so far as those required for British trade are concerned), will be 1s. 5.335d., to which shipping expenses, etc., from the United States to India have to be added. The equivalent in sterling (British currency) of dollar silver is 46.65d. per standard ounce, calculated at the current exchange rate.

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date		Average week ending	
May	1	Mch. 26	7.25
"	2	Apr. 2	7.19
"	3	" 9	7.13
"	4	" 16	7.00
"	5 Sunday	" 23	6.95
"	6	" 30	6.83
"	7	May 7	6.72

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. In February 1918 the Government fixed prices for grade A spelter at 12c. per lb. for itself and the open market. This grade constitutes only a small proportion of the total output. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c. per pound.

Date		Average week ending	
May	1	Mch. 26	7.56
"	2	Apr. 2	7.33
"	3	" 9	7.23
"	4	" 16	7.00
"	5 Sunday	" 23	7.00
"	6	" 30	6.88
"	7	May 7	7.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date		Apr. 23	115.00
Apr.	9	" 30	115.00
"	16	May 7	110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	319.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115.00	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Eastern Metal Market

New York, May 1.

Interesting news features are not prominent while marked inactivity continues as at present. The markets are all quite lifeless.

The copper market waits now on the decision this week concerning the fixed price to be effective after June 1.

Tin prices are at unheard-of levels for all positions, and buying is at a standstill because of lack of offerings.

Lead is declining and is very quiet.

Zinc is a little stronger and somewhat steadier.

Antimony has firmed slightly.

The most momentous development of the War affecting the steel industry was the pledge of all the leading steelmakers of the country, given at New York last week, to the director of steel purchases, J. L. Replogle, that they would operate on Government orders to the exclusion of commercial business. The Washington view is that the amount of steel that must be delivered in the next few months to the Government, its Allies, and all domestic industries engaged in war and similar work, has been under-estimated in the industry which quickly agrees that a 100% operation is the only convincing answer. Some producers think that a 60-day concentration on Government orders will make it possible to resume general business to some extent, but the War Industries Board does not encourage this view. The plan is to hold the steel men strictly to their pledge, and a close check will be kept on all deliveries to individual account.

COPPER

There is practically no change in the situation, and the trade is marking time, with interest concentrated in the meeting today and later this week in Washington between copper producers and the War Industries Board to discuss the price of copper that is to obtain after June 1. Speculation is quite free as to the outcome, but of course no one knows the result. Many are confident that there will be no lowering of the 23.50c. level, and some feel sure that it will be advanced to 25c. It is recognized that the supply in the shape of production must be kept at the maximum if the present enormous needs are to be met. Whether a price-advance is necessary to do this must be decided this week. Six important companies report 14.7% decrease in output for March as compared with the same month in 1917. Others show a substantial increase. Exports are declining. Those for March are reported as 22,556 tons, not including those to Canada. An estimate, including Canada, puts the exports for the first quarter at 93,447 tons, which compares with 134,805 tons for the first quarter of 1917, or a decrease of about 32%.

TIN

Some anxiety was apparent late last week when the announcement appeared that Holland had placed an embargo on shipments of Banca tin. This is denied, but the real facts are not known. It is regarded as probable in the trade, however, that the metal will be permitted to come forward under license, the same as British tin. It is pointed out now that the Holland tin trade is too important and valuable to Holland to be entirely cut off. In England it is evident that some new regulations in the tin situation are on foot, but it is more or less uncertain what they are. Thus far it is sure that one cannot buy or sell tin except by first getting a Government license, and this may eventually mean complete control, which thus far has not existed. The market is quiet and offerings are scanty, resulting in a dull situation. Buyers are getting on the anxious-seat, and the situation is not reassuring. Prices continue to advance, both here and elsewhere. Spot tin is unobtainable, but is now quoted nominal at 95c., New York, with higher prices reported as having been paid for little lots. The London market keeps going up. Yesterday spot Straits was quoted at £361 per ton, an advance of £18 per ton since a week ago. These are unheard-of prices. Arrivals to April 23, inclusive, are reported to have been 480 tons, with 5000 tons estimated afloat.

LEAD

General conditions are unchanged from those prevailing last week. Most large producers are well sold up for May, and the market is still not quite equal to taking all the lead offered by smaller interests. The large Western producer has adjusted his labor troubles and is again in operation. The market is quiet and dull, with the tendency downward. Buying has been and is scant, and offerings are moderate in quantity. There are both bullish and bearish factors in the situation, with the latter at present the determining ones, but a revival of demand would at once result in a strong market. Spot lead is quoted and sold at 7.12½c., New York, but not actively. The American Smelting & Refining Co. has not changed its quotation of 7c., New York, but it may do so any day, for the outside market is now 6.80c., New York, and 6.62½c., St. Louis.

ZINC

The market is stiffer and stronger and has a firmer undertone than for the last two or three weeks. Consumers are displaying a little more interest, but it is not marked. Prime Western for early and May delivery is quoted today at 6.75c., St. Louis, or 7c., New York. On Thursday it sold at 6.70c., St. Louis. For futures 6.80 to 6.85c., St. Louis, has been obtained.

ANTIMONY

A somewhat better demand, both Government and domestic, has slightly strengthened the market, which is now quoted at 13 to 13.25c. per lb., duty paid, New York, for Chinese and Japanese grades for prompt and early delivery. Some believe the bottom has been touched.

ALUMINUM

No. 1 virgin metal, 98 to 99% pure, is officially controlled at 32c. per lb. for 50-ton lots with lots of 15 to 50 tons fixed at 32.10c. per lb., and of 1 to 15 tons at 32.20c. per pound.

ORES

Antimony.—The quotation is unchanged at $1.75 per unit. There is no interest on the part of buyers.

Ferro-manganese.—All importers here of British ferro-manganese, and some consumers, have protested individually against the Government order to prohibit imports after May 13. A modification of the order is hoped for. Imports in March were 3555 tons, which is more than those for January and February combined.

Molybdenum.—Buyers are scarce, and offerings of molybdenite at present are not obtaining takers.

Tungsten.—The market has not been active. Quotations are unchanged at $24 per unit in 60% concentrates for high-grade wolframite, and $24.50 for scheelite, with off-grade ores bringing a correspondingly lower price. Ferro-tungsten is bringing about $2.25 to $2.35 per lb. of contained tungsten.

Dividends From Mines, United States and Canada

UNITED STATES

Company and situation	Metal	Shares issued	Par value	Paid in 1918	Total	Latest dividends Date	Amount
Ahmeek, Michigan	copper	200,000	$25.00	$400,000	$8,850,000	April 10, 1918	$2.00
Allouez, Michigan	copper	100,000	25.00	300,000	.....	April 3, 1918	1.50
Anaconda, Montana	c.z.s.g.	2,331,250	50.00	4,662,500	142,370,000	April 25, 1918	2.00
American Z. L. & S., United States.	c.l.z.s.g.	96,560 193,120	25.00 25.00	144,840	.....	May 1, 1918	1.50 ...
Atolia, California	tungsten	100,000	1.00	1,300,000	4,564,500	Feb. 15, 1918	1.00
Arizona, Arizona	copper	1,519,896 £316,530	1.20 7% pfd.	53,000 639,000	2,131,000 20,621,000	May 1, 1918 Mch. 20, 1918	... 0.42
Barnes-King, Montana	gold	400,000	5.00	80,000	180,000	May 15, 1918	0.10
Bingham Mines, Utah	l.s.g.	150,000	10.00	150,000	337,500	April 1, 1918	0.50
Brunswick, California	gold	395,287	1.00	.....	203,315	Sept. 15, 1915	0.06
Bunker Hill & Sullivan, Idaho	l.s.	327,000	10.00	.....	20,860,500	.....	...
Caledonia, Idaho	l.s.	2,605,000	1.00	78,150	3,220,200	May 6, 1918	0.03
Calumet & Hecla, Michigan	copper	100,000	25.00	1,000,000	146,250,000	Mch. 22, 1918	10.00
Center Creek, Missouri	z.l.	100,000	10.00	10,000	660,000	April 1, 1918	0.05
Champion, Michigan	copper	100,000	25.00	640,000	21,994,541	Jan. 7, 1918	6.40
Chief Con., Utah	l.z.s.g.c.	884,223	1.00	176,840	1,013,811	May 6, 1918	1.50
Chino, New Mexico	copper	869,980	5.00	1,304,970	22,488,132	Mch. 30, 1918	1.50
Cerro Gordo, California	l.z.s.	975,000	1.00	.....	175,000	Oct. 15, 1917	0.05
Copper Range, Michigan	copper	394,399	25.00	591,599	23,054,220	Mch. 15, 1918	1.50
Con. Interstate-Callahan, Idaho	z.l.s.	464,990	10.00	232,495	6,509,860	Jan. 2, 1918	0.50
Continental Zinc, Missouri	z.l.	22,000	5.00	11,000	396,000	Jan. 2, 1918	0.50
Con. Arizona, Arizona	c.s.g.	1,663,000	5.00	83,150	415,750	Mch. 15, 1918	0.05
Cresson, Colorado	gold	1,220,000	1.00	610,000	6,173,167	May 10, 1918	0.10
Daly, Utah	l.s.g.	150,000	20.00	15,000	3,000,000	April 1, 1918	0.10
Dragon Con., Utah	c.l.s.g.	1,875,000	1.00	37,500	112,500	April 25, 1918	0.01
Ducktown, Tennessee	copper	198,000 200 founders	4.80	.....	2,678,702	May, 1917	0.96 623.34
East Butte, Montana	copper	411,000	10.00	.....	411,000	Jan. 29, 1917	1.00
Electric Point, Washington	lead	793,500	1.00	.....	.....	.....	...
Elko Prince, Nevada	gold	1,108,566	1.00	110,856	166,284	April, 1918	0.05
Empire, Idaho	copper	1,000,000	1.00	50,000	830,000	Jan. 2, 1918	0.05
Engels, California	copper	1,791,926	1.00	52,953	481,658	Feb. 15, 1918	0.01½
Federal, Idaho	l.z.s.	120,000 60,000	100.00 100.00	210,000	9,240,000 2,850,000	Mch. 15, 1918 Jan. 15, 1909	1.75 ...
General Development, U. S	.....	120,000	25.00	120,000	4,703,917	Mch. 1, 1918	1.00
Golden Cycle, Colorado	gold	1,500,000	1.00	135,000	8,313,500	Mch. 10, 1918	0.03
Goldfield Con., Nevada	gold	3,559,148	10.00	.....	28,999,832	Oct. 31, 1915	0.10
Grand Central, Utah	l.s.	500,000	1.00	25,000	1,759,750	April 12, 1918	0.05
Calumet & Arizona, Arizona	copper	642,480	10.00	.....	35,992,762	.....	...
Hecla, Idaho	l.s.	1,000,000	0.25	50,000	6,955,000	Jan. 20, 1918	0.05
Inspiration, Arizona	copper	1,181,967	20.00	2,363,934	18,299,279	Jan. 28, 1918	2.00
Iron Blossom, Utah	l.s.g.	1,000,000	0.10	25,000	3,125,000	April 25, 1918	0.02½
Iron Cap, Arizona	copper	144,872	10.00	72,430	416,907	Mch. 1, 1918	0.25
Isle Royale, Michigan	copper	150,000	25.00	75,000	.....	April 30, 1918	0.50
Jim Butler, Nevada	s.g.	1,718,021	1.00	171,802	1,030,813	Feb. 1, 1918	0.10
Judge, Utah	l.z.c.s.g.	400,000	1.00	40,000	2,130,000	April 1, 1918	0.12½
Kennecott, Alaska	copper	2,786,679	5.00	2,786,679	.....	Mch. 31, 1918	1.00
Magma, Arizona	copper	240,000	5.00	120,000	1,344,000	Mch. 30, 1918	0.50
Mary Murphy, Colorado	g.s.l.z.	370,000	5.00	.....	93,106	April, 1916	0.07
Mass Con., Michigan	copper	100,000	25.00	.....	500,000	Aug. 15, 1917	1.00
Miami, Arizona	copper	747,114	5.00	1,767,785	18,100,816	May 15, 1918	1.00
Mohawk, Michigan	copper	100,000	25.00	.....	.....	.....	...
Nevada Con., Nevada	copper	1,999,457	5.00	1,999,457	38,770,979	Mch. 1918	1.00
New Idria, California	quicksilver	100,000	5.00	50,000	2,580,000	April 1, 1918	0.50
North Butte, Montana	c.s.g.	430,000	15.00	215,000	14,452,000	April 29, 1918	0.25
North Star, California	gold	250,000	10.00	50,000	5,387,040	Mch. 29, 1918	0.20
Old Dominion, Arizona	c.s.g.	293,353	25.00	293,353	13,187,538	Mch. 29, 1918	1.00
Osceola, Michigan	copper	96,150	25.00	384,600	16,794,875	April 30, 1918	2.00
Phelph-Dodge, Ariz., N. Mex., Mex.	c.s.g.	450,000	100.00	3,600,000	70,196,527	Mch. 29, 1918	8.00
Portland, Colorado	gold	3,000,000	1.00	180,000	11,137,080	April 20, 1918	0.03
Prince Con., Nevada	l.s.	1,000,000	2.00	.....	575,000	Nov. 1, 1917	0.02½
Quincy, Michigan	copper	110,000	25.00	275,000	25,792,500	Mch. 25, 1918	2.50
Ray Con., Arizona	copper	1,577,179	10.00	1,577,179	17,132,431	Mch. 30, 1918	1.00
Shannon, Arizona	copper	300,000	10.00	.....	1,425,000	Nov. 15, 1917	0.25
Shattuck, Arizona	c.l.s.g.	350,000	10.00	525,000	6,912,500	June 30, 1918	0.50
Silver King Con., Utah	l.s.c.g.	700,000	1.00	70,000	1,562,705	April 1, 1918	0.10
Tennessee Copper, Tennessee	copper and acid	391,498	no par value	391,498	.....	May 15, 1918	1.00
Tomboy, Colorado	g.s.	310,000	4.80	31,000	4,037,000	Dec. 31, 1917	0.24
Tonopah Belmont, Nevada	s.g.	1,500,000	1.00	187,500	9,330,559	Jan. 1, 1918	0.12½
Tonopah Extension, Nevada	s.g.	1,282,801	1.00	.....	1,912,399	April 2, 1917	0.10
Tonopah Mining, Nevada	s.g.	1,000,000	1.00	75,000	14,650,000	April 20, 1918	0.07½
Union Con., Nevada	s.g.	200,000	1.00	.....	.....	.....	0.05
United Copper, Washington	copper	1,000,000	1.00	.....	150,000	Oct. 15, 1917	0.01
United Eastern, Arizona	gold	1,363,000	1.00	272,600	681,500	April 26, 1918	0.05
U. S. S. R. & M., U. S., Mexico	l.z.c.s.g.	pfd. 486,350 com. 351,115	50.00 50.00	851,112 877,788	20,625,705 10,312,387	April 15, 1918 April 15, 1918	0.87½ 1.25
United Verde Copper, Arizona	copper	300,000	no par value	4,650,000	50,597,000	May, 1918	1.50
United Verde Extension, Arizona	copper	1,050,000	0.50	1,575,000	787,500	May 1, 1918	0.75
Union Con., Nevada	s.g.	200,000	1.00	60,000	.....	May 1, 1918	0.05
Utah Con., Utah	c.l.s.g.	300,000	5.00	150,000	13,917,000	Mch. 25, 1918	0.50
Utah Copper, Utah	copper	1,624,490	10.00	4,061,425	79,832,308	Mch. 30, 1918	2.50
Utah Metal, Utah	l.c.g.s.	691,588	1.00	.....	895,734	Dec. 10, 1917	0.30
Vindicator Con., Colorado	gold	1,500,000	1.00	.....	3,712,500	Oct. 25, 1917	0.03
Wellington Mines, Colorado	l.z.	1,000,000	1.00	100,000	1,750,000	Jan. 1, 1918	0.10
West End, Nevada	s.g.	1,788,486	5.00	178,848	894,243	Mch. 1, 1918	0.10
Yellow Aster, California	gold	1,064,310	1.00	35,000	1,245,789	July 20, 1917	0.05
Yellow Pine, Nevada	z.l.	1,000,000	1.00	60,000	2,070,000	Mch. 2, 1918	0.06
Yukon Gold, Alaska; Yukon; California; Nevada	gold	3,500,000	5.00	87,500	.....	Mch. 30, 1918	0.02½

CANADA

Coniagas, Ontario	silver	800,000	5.00	100,000	8,840,000	Feb. 2, 1918	0.12½
Con. M. & S., British Columbia	l.c.z.s.g.	419,098	25 00	523,872	4,470,233	April 2, 1918	0.62½
Granby Con. M. S. & P. B. C	c.g.s.	150,004	100 00	750,020	.....	May 1, 1918	2.50
Hedley, British Columbia	gold	120,000	10.00	36,000	2,340,000	Mch. 30, 1918	0.30
Hollinger, Ontario	gold	4,920,000	5.00	.....	8,194,000	April 23, 1917	0.05
Howe Sound, British Columbia	copper	1,984,150	1.00	99,207	99,207	April 15, 1918	0.05
International Nickel, Ontario	n.c.	com. 1,673,384 pfd. 89,126	25.00 100.00	133,689 1,673,384	.....	May 1, 1918 Mch. 1, 1918	1.50 1.00
Kerr Lake, Ontario	silver	600,000	5.00	300,000	7,710,000	June 15, 1918	0.25
McKinley-Darrach, Ontario	silver	2,247,692	1.00	134,861	5,281,083	April 1, 1918	0.03
McIntyre, Ontario	gold	3,610,283	1.00	180,514	722,056	Jan. 31, 1917	0.05
Mining Corn., Ontario	silver	1,660 050	5.00	415,013	3,320,060	Mch. 15, 1918	0.25
Nipissing, Ontario	silver	1,200 000	5.00	300,000	17,730,000	April 20, 1918	0.25
Standard, British Columbia	l.z.s.	2,000,000	1.00	.....	2,700,000	Oct. 15, 1917	0.05
Temiskaming, Ontario	silver	2,500,000	1.00	75,000	2,125,000	Jan. 18, 1918	0.03
Tough-Oakes, Ontario	gold	531,500	5.00	.....	398,625	Jan. 15, 1917	0.12½

Abbreviations: g = gold, s = silver, c = copper, l = lead, z = zinc.

Note: Companies not included in the above list are requested to submit details. Changes in capitalization and new dividends will be entered on receipt of the information. This table will be published quarterly.

Book Reviews

Handbook of Hydraulics. By Horace W. King. Pp. 413. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press', San Francisco. Price, $3.

This book will be particularly valuable as a reference book for the practising engineer, although it will also be useful for the student. The opening chapters deal with hydraulic units and the fundamental principles of hydrostatics. Following this, the flow of water through orifices, over sharp-crested weirs and weirs not sharp-crested, through pipes, and in open channels is discussed in order. The next chapter considers methods and instruments for measuring water, and the preparation of discharge-records and expected storage-curves. The final chapter of the text deals with various special problems. There are two appendices, one on the comparison of weir formulas with experiments, and the other on the comparison of the Kutter, Manning, and Bazin formulas with the experiments recently made by F. C. Scobey of the U. S. Department of Agriculture. An unusually complete set of tables is included, comprising practically every mathematical table that the hydraulic engineer might need. There are also a number of diagrams and other illustrations.

Useful Minerals and Rare Ores. Second edition. By Alexander McLeod. Pp. 254, index. John Wiley & Sons, New York, 1917. For sale by 'Mining and Scientific Press.' Price, $1.75.

In these times, when the search for all minerals, especially the rarer ones, is so keen, a pocket manual giving the simplest tests is a necessary companion. The book before us is thoroughly practical. We remember the first edition, and found it useful; the second is much better. A small outfit of apparatus and chemicals, combined with a fair knowledge of ore occurrence and common-sense, is all the prospector and student needs. As secondary enrichment of orebodies is of such great importance, 24 pages are devoted to this subject following prospecting hints. The preliminary examination of the minerals and metals covers 100 pages, this followed by the remainder of the book describing physical and other simple tests for identifying metals and ores. A few pages are devoted to gems. Additional identification tests include soda on the charred rod, streaks, minerals that fly to pieces when laid on glowing wood, and when heated in a glass tube closed at one end, and minerals that contain volatile elements which cover a glass tube with a coating. We do not hesitate to recommend this practical little treatise to all interested in the mineral industry.

Petroleum Geology of Wyoming. L. W. Trumbull. Pp. 78. Ill., index. G. G. Bovee, Cheyenne, Wyoming. For sale by 'Mining and Scientific Press.' Price, $5.

This book contains the first comprehensive discussion of the subject that has been published. Hitherto, although a considerable part of the data contained in the present volume had been published, it was scattered through a number of Federal and State geological reports, while a good deal of it has never been published. The author is State geologist of Wyoming. The first part of the book is devoted to the geological history of the State, with particular regard to the oil-bearing horizons. A brief description is then given of each of the various oilfields, both producing and prospective. Geological sections are shown for the principal fields, as well as a number of well-logs. Land titles are discussed, also methods of leasing the State school-lands. There is an insert map of the entire State on a scale of about 20 miles to the inch, showing the principal geological features. The book contains a number of attacks on the policy of the General Land Office and other Federal officials, which, while perhaps excusable in a newspaper article, are, irrespective of the merits of the case, entirely out of place in a book of this character. The book will be of value to people directly interested in oil-development in Wyoming. Its usefulness would, however, have been materially increased if a chapter or two had been added regarding drilling and operating conditions in the various fields.

Relief From Floods. By John W. Alvord and Charles B. Burdick. Pp. 169. Ill., index. McGraw-Hill Book Co., Inc., New York. For sale by 'Mining and Scientific Press', San Francisco. Price, $2.

The curve of damage from floods in most countries shows a general tendency to rise and is likely to continue to do so unless more energetic and more intelligent measures are taken for flood-control. The present volume is particularly valuable as indicating what such measures should be. While many of the illustrations are naturally drawn from conditions in Ohio, with which the authors are most familiar, the general principles are equally applicable to flood-control problems in other parts of the world. The first chapter discusses damage from recent floods and the records of floods on different streams. Little credence is given to the popular belief that floods are increasing either in size or in frequency, or that deforestation, except in a few special cases, has much to do with increasing flood-volumes. The next chapters are devoted to methods of investigating flood-control problems and of predicting future floods from past records, particular attention being paid to the formulas developed by W. E. Fuller based on the ratio between average floods and the floods that may be expected once in a given period of years. The next chapter deals with channel improvements for protection against floods, including cut-offs, channel enlargement, and the construction of levees. The final chapter discusses flood-control by water-storage. There are a number of useful tables and diagrams included.

Popular Oil Geology. By Victor Zeigler. Pp. 144. Ill., index. C. H. Merrifield, Golden, Colorado. For sale by 'Mining and Scientific Press', San Francisco. Price, $2.50.

This book is based on a series of lectures recently delivered by the author, who states in the preface that it is not intended for the experienced oil geologist but rather for the man without technical training in this branch of geology. Writing a book on a technical subject for the non-technically trained reader is a difficult task. There is always danger either of explaining too much or not explaining enough. Thus the present author in discussing capillary pressure states that it is a function of the surface-tension of the liquid although it is probable that any reader who needed to have capillary pressure explained to him would stand in even greater need of a definition of surface-tension, and, for that matter, of function as well. Such shortcomings, however, are relatively unimportant, and the book as a whole should be valuable for the class of readers for which it is intended, particularly those who are interested in either the Colorado or the Wyoming oilfields. The first chapter is devoted to general history and statistics of the petroleum industry. The next discusses the physical and chemical properties of oil and gas, following which is a brief discussion of the various theories of the origin of oil and gas. Several chapters are then given to a discussion of those geological phenomena that affect the migration and accumulation of oil, and to the application of a knowledge of these

phenomena to prospecting for oil. A chapter is devoted to oil-shale, and one to oil investments.

Chemical French. A study of French chemical literature. By Maurice L. Dolt. Pp. 398, index. The Chemical Publishing Co., Easton, Pa., 1918. For sale by 'Mining and Scientific Press.' Price, $3.

The Chemical Publishing Co. has done the English-speaking world a service by bringing out a book that will assist students to the correct interpretation of French chemical literature. It begins with the old-fashioned method of the acquisition of a language, with vocabularies and exercises which, however, rapidly introduce the words that are in common use in technology, so that before the student will have gone through more than 32 pages, he will have begun to use the language of the French chemist and will be fitted to proceed to an understanding of such subjects in the French language, if accompanied by parallel study in the grammar or in some other work for learning the fundamentals of the idiom. The student will especially appreciate the glossary, which is in reality a little dictionary of 74 pages, giving the words that are necessary in reading chemical literature. We welcome the book for another reason. The time has passed when students from the United States will go to Germany to acquire their training in technology. It has been recognized at last that the German training, although a minutely exact one, is lacking in those features that strengthen the constructive powers. We realize, now that we are able to see Germany more clearly with the mask torn off, that the great advance in the development of chemical theory has been made by the French, the English, the Americans, the Italians, but not by the Germans. We have discovered that treasures of scientific investigation are locked up in the French language, and that the greatest progress in the study of chemistry, with a view to its further development, is to be obtained by absorbing the fruits of the work of the great French investigators.

American Lubricants. From the standpoint of the consumer. By L. B. Lockhart. Pp. 236, ill., index. The Chemical Publishing Co., Easton, Pa., 1918. For sale by 'Mining and Scientific Press.' Price, $2.

The present war has been termed as one of applied science, in which gasoline and lubricants play extremely important parts. Lubrication of rapid or slowly-moving machinery requires more skill than is generally supposed, whether it be a watch, 10,000-kw. turbo-generator, or planing-machine. It is essential that an engineer know the grade of oil he is using, its viscous nature, also from what base oil it was made. In this book he will find such matters discussed practically; also many tests on a variety of lubricants. Grease is used in increasing amounts for lubricating heavy machinery, also even for moderate-speed shafting and inaccessible parts. Graphite and mica are often mixed with grease to advantage. Animal and vegetal oils find a place in many plants, and are described. With the enormous expansion in the use of automobiles and internal-combustion engines, lubrication requires much study, but in this case the consumer of oil need not bother much, as the manufacturer has designed the system to take care of the high temperatures produced. Lubrication of electrical machinery, steam engines and locomotives, cotton mills, and the like, receive due consideration. Stress is laid on the fact that railroad and power-plant companies, which allow a fixed quantity of lubricants for the machines in use, make a costly mistake in so doing, as often their engine-men need oil badly and cannot get any. Seven short chapters on specifications for oils, and various tables conclude a book for every consumer of lubricants.

Recent Publications

The following are arranged according to the minerals discussed:

COAL

Coal Products. By C. G. Gilbert. Bull. 102, part 1. Smithsonian Institution, Washington, 1917. Pp. 16, with 9 plates.

Coal: The Resource and Its Fuel Utilization. By C. G. Gilbert and J. E. Progue. Bull 102, part 4. Smithsonian Institution, 1918. Pp. 26.

Combustion of Coal and Design of Furnaces. By Henry Kreisinger, C. E. Augustine, and F. K. Oritz. Bull. 135, U. S. Bureau of Mines, 1917. Pp. 144, ill, index.

Five Ways of Saving Fuel in Heating Houses. By Henry Kreisinger. Paper 199, U. S. Bureau of Mines, 1918. Pp. 10, illustrated.

New Views on the Combustion of the Volatile Matter in Coal. By S. H. Katz. Paper 183, U. S. Bureau of Mines, 1918. P. 13, illustrated.

COPPER

Flotation of Chalcopyrite in Chalcopyrite-Pyrrhotite Ores of Southern Oregon. By Will H. Coghill. Paper 182, U. S. Bureau of Mines, 1918. Pp. 10, illustrated.

GOLD

Annual Report of the Director of the Mint for the Year Ended June 30, 1917; including Report on Production of the Precious Metals in the Calendar Year 1916. Washington, 1917. Pp. 271, index.

Gold Deposition in the Bendigo Goldfield. By F. L. Stillwell. Bull. 4, published by Advisory Council of Science and Industry of the Commonwealth of Australia, Melbourne, 1917. Pp. 68, with 13 plates.

IRON

Concentration Experiments with the Silicious Red Hematite of the Birmingham District, Alabama. By Joseph T. Singerwald Jr. Bull. 110. U. S. Bureau of Mines, Washington, 1917. Pp. 91, ill., map, index.

Iron-Ore Occurrences in Canada. Vol. II. Compiled by E. Lindeman and L. L. Bolton, with introduction by A. H. A. Robinson. Department of Mines, Ottawa, Canada, 1917. Pp. 222, pocket with 33 maps, index.

OIL

Laws Pertaining to Oil. By M. A. Allen. Bull. 84, University of Arizona Bureau of Mines, Tucson, 1917-18. P. 12.

SALT

Technology of Salt Making in the United States. By W. C. Phalen. Bull. 146, U. S. Bureau of Mines, 1917. Pp. 149, ill., index.

SULPHUR

Sulphur: An Example of Industrial Independence. By J. E. Pogue. Bull. 102, part 3, Smithsonian Institution. Pp. 10, with 3 plates.

Utilization of Pyrite Occurring in Illinois Bituminous Coal. By E. A. Holbrook. Circular No. 5, University of Illinois Engineering Experiment Station, 1917. Pp. 42, illustrated.

TIN

Tin Deposits Near Irish Creek, Virginia. By H. G. Ferguson. Bull. XV-A, Virginia Geological Survey, Charlottesville, 1918. Pp. 19, illustrated.

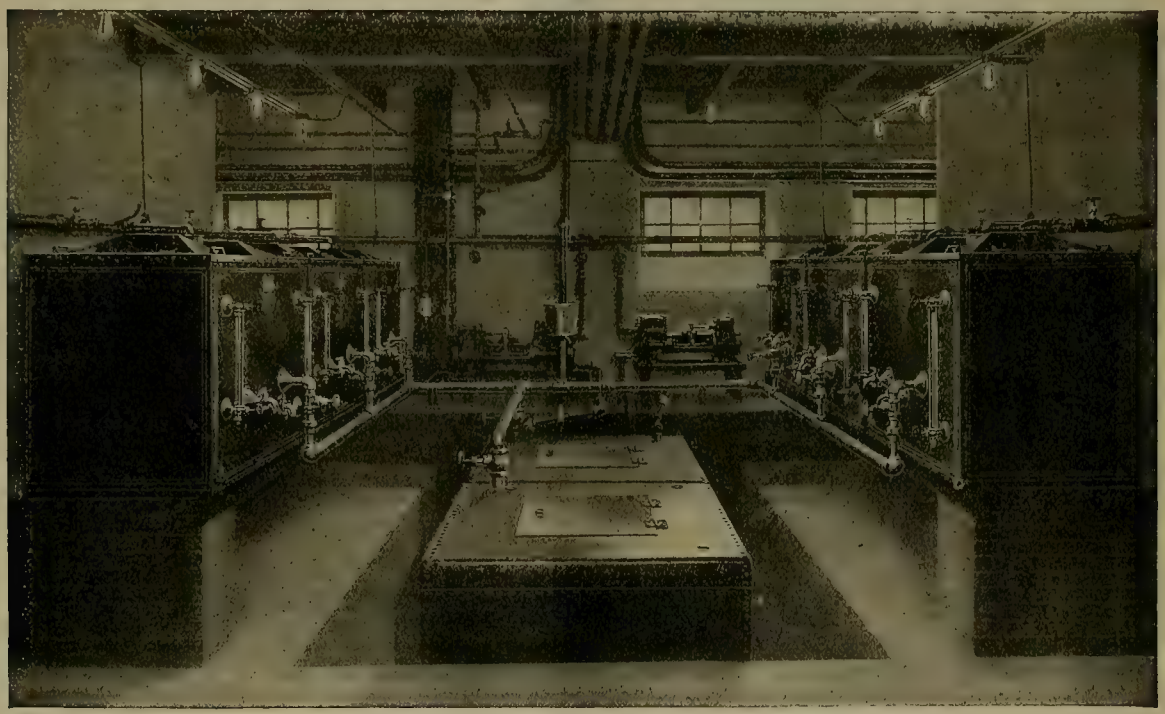
Mine Sampling and the Commercial Value of Ores. By Robert S. Lewis. Bull. No. 10, University of Utah, Salt Lake City, March 1918. Pp. 32. Illustrated.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

BURT OIL FILTRATION

In the Burt oil filter, 'unit type,' the dirty oil enters the waste-oil receptacle (see sectional cut) and passes through the small perforations, flowing thence horizontally to the two filtering cylinders, and in passing to these cylinders the heavy impurities fall by gravity into the sediment pan, and therefore do not clog the filtering cloths or filtering material. Each cylinder is wrapped with a cloth through which the oil must pass before entering the filtering cylinder. After the dirt and grit falls into the sediment pan. Those acquainted with other makes of filters will understand the advantage of this. In other filters the bulk of the sediment is at the bottom of the filter instead of at the top. When it is at the top it can be removed readily without interfering with the supply of pure oil for the oiling system. Owing to the effect of the hot-water chamber at the top, the Burt oil filter, 'unit type,' will filter from 50 to 75% more oil than any other style occupying an equal amount of space. This filter will handle successfully the heaviest grades of oil,



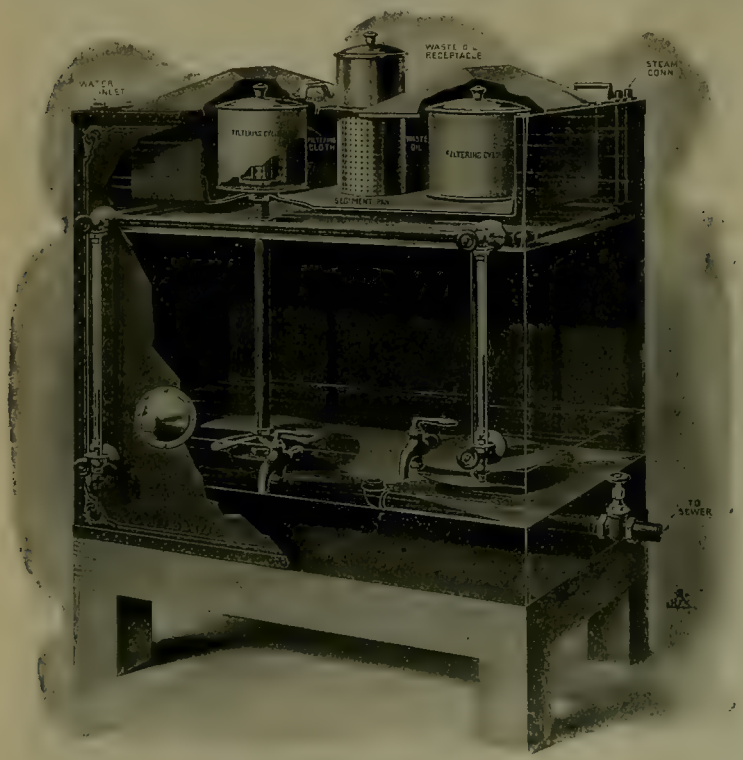
INSTALLATION OF 'UNIT' OIL-FILTER IN MT. VERNON STREET POWER-HOUSE OF PHILADELPHIA RAPID TRANSIT COMPANY

going through a quantity of bone-black, the oil passes downward through the two tubes into the bottom of the filter. By means of plates attached to the bottom of the tubes, the oil is spread in a thin film and is thoroughly washed by the water. Any impurities remaining in the oil drop to the bottom of the filter and can be flushed out at any time by opening the gate-valve, which connects with the sewer.

The hot-water chamber in the upper part of the Burt filter is an important detail. It is found only in the Burt style, and is covered by patent. The object in heating the oil before filtering, is to cause it to flow more freely, thus increasing the speed of filtration and the filtering capacity. When the dirty oil is heated, it spreads out, and most of such as lard, crank-case, gas engine, cylinder, and other kinds. The heating arrangement will make the heaviest grade of oil flow freely and filter easily. Hence, it is hardly necessary to say that the Burt will filter common engine or machine oil to perfection.

The 'unit' filters are so constructed that they can be used with or without an oiling system, a feature which should have full consideration by every prospective buyer of an oil filter. The latest engineering practice indicates that within a few years almost every power-plant of average size will be equipped with an oiling system of some description. The 'unit filters' can, if desired, be installed and operated at first without being connected to an oiling system, and if,

later on, an oiling outfit is added to the plant, pipe connections can be readily made to the filter without extra expense. In cleaning the Burt filter, 'unit type,' it is not necessary to shut-down the whole system and disconnect the piping. If more than one unit is used, all that is necessary is to shut off the flow of oil to the filter to be cleaned, allowing the other filter to handle an extra amount. Where only one filter is installed, the cleaning operation is simple. The cloth around one cylinder can be removed instantly, and if the filtering material also needs to be removed, unscrew one cylinder and screw a plug, which is furnished for that purpose, into the tube, so as to keep the dirty waste-oil from flowing into the filter. The other cylinder will continue in



SECTIONAL VIEW OF UNIT FILTER

operation while the first is being cleaned. Any kind of filtering material can be used in the cylinder, such as white waste, sponges, excelsior, or raw wool. Each cylinder is wrapped with a filtering cloth and contains a quantity of bone-black. Animal bone-black is used in all oil refineries to purify lubricating oil, and we therefore believe it to be a suitable filtering medium. This material can be washed out with hot water or gasoline and used over and over again, so that there is practically no expense for filtering.

The Burt filter is particularly desirable for use with gas or gasoline engines of large capacity, as the hot water from the engine cylinders can be used for the purpose of heating the oil. Where gas engines of large size are used, the 'unit filter' can be employed with excellent results, as the filter is furnished with special connections so that the hot water from the gas engine cylinder can be circulated in the upper part of the filter.

Each unit is so constructed that it can be used in connection with, or independent of, an oiling system, so that in case additional machinery is added to a power-plant at any time and increased filtering capacity becomes necessary, any number of units can be added, and can either be operated together as one filter or separately, as desired, without changing the pipe-connections. The water in the bottom of the three units can be drained into the sewer by opening one valve, and the supply of pure oil can also be regulated by one valve. Any number of filters can be placed in a row or in any position desired, and the piping arranged accordingly.

Among recent installations of 'unit filters' for use in connection with steam turbines may be mentioned those for the De Laval Steam Turbine Co., Trenton, N. J.; The B. F. Goodrich Co., Akron, O.; Diamond Rubber Co., Akron, O.; New Orleans Railway & Light Co., New Orleans, La. (2); Bahia Electric Tramway Co., Bahia, Brazil; De Beers Con. Mines Ltd., Kimberly, South Africa; Syracuse Lighting Co., Syracuse, N. Y.; Columbia Electric Railway, Light & Power Co., Columbia, S. C. (2); Fort Wayne & Wabash Valley Traction Co., Fort Wayne, Ind. (3); and many others, names of which will be cheerfully furnished upon application.

DISTILLATION OF LIGNITE

Efforts are being made in France to introduce the distillate of lignite for tars. The Societe de Distillation des Combustibles, Paris, is constructing an improved Ziegler type of furnace similar to that used for the distillation of peat, a type yielding about 7% of tar which is treated by fractional distillation carried out 'in vacuo,' to increase the output of heavy products; followed by chemical purification by washing with dilute sulphuric acid and soda, to remove the picolines, cresols, and other products. The crude paraffine, extracted by crystallization of the heaviest oils, is first passed through the filter-press. The purification consists of a series of filterings in the filter-press, and meltings in the light oil. The last traces of oil are removed by scrubbing with super-heated steam, and the paraffine wax is clarified by filtering through animal black. In one place in Germany, where the system was adopted, 70 to 80% of marketable products was obtained from lignite tar, namely, 15 to 20% paraffine wax, 5 to 20% kerosene; 5 to 15% of creosotes and organic acids; the remainder being light products, petrol, etc., or heavy products such as gas-oils and lubricating oils. Concurrently with the great interest taken in the development of the shale-oil industry in America, it is worth while to consider the possibility of utilizing the large deposits of low-grade lignites for another set of greatly needed chemicals, including the fixed nitrogen which can be converted into ammonium sulphate. Among the available products are benzol and toluol, and the gas can be employed in many places for industrial purposes.

The Asbestos Protected Metal Co. of Pittsburgh, effective on May 1, 1918, will be known as the Aspromet Company. When this concern was established in 1905, its sole product was asbestos protected metal. The initial product met with such universal favor that it resulted in complementing this by adding other articles to their other lines of building materials commonly used and bought by the same people who purchase asbestos protected metal. The company now has a wide variety of specialties for building purposes, many of which contain neither asbestos nor metal in their make-up. Thus, the descriptive name, 'Asbestos Protected Metal Co.', which originally served a useful purpose became restrictive to the point of being misleading; hence the change.

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By H. C. Hoover 685

This is a speech delivered before the Pittsburgh Press Club on April 18. The primary concern of the Food Administration is the feeding of the people of the United States and those of the Allies, thereby maintaining the strength of all, the strong arm of the army. The shipping situation demanded that food resources be taken in hand and adjusted. The most essential products are those that must be carried to Europe first. Co-operation with producers, manufacturers, distributers, and consumers of food is absolutely necessary to gain the ends desired. M. & S. P., May 18, 1918.

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EDITORIAL

ON May 13 the Ninth Circuit Court of Appeals, in San Francisco, delivered its opinion in the case of Minerals Separation v. Butte & Superior. The judgment of the Montana court is reversed, in favor of the Butte & Superior Mining Company. We look forward now to a re-consideration of the issue by the Supreme Court of the United States. As soon as the text of this decision is available, we shall give it to our readers.

ANOTHER estimate of the world's production of gold in 1917 is forthcoming. The London 'Statist' makes the total £87,983,120, equivalent, at $4.85, to $426,718,-132. This compares with our estimate, appearing in the issue of May 4, of $414,169,744 and with that given by Mr. Hennen Jennings, last week, of $430,000,000. The 'Statist' quotes the United States Mint figures for Mexico, namely, £2,500,000, which compare with our guess of $10,000,000. In the absence of statistical data we believe it correct to infer that the production was considerably less in 1917 than it was in 1916. The Russian output is given as £4,000,000, which is practically identical with our estimate of $20,000,000. 'Other countries' are credited by the 'Statist' with $40,000,000, whereas our estimate was $28,000,000. If the principal gold-producing countries for which statistics are available show a decrease ranging from 3% to 17%, it is extremely unlikely that the 'other countries' continued to produce in 1917 at the same rate as in 1916, but that is what the 'Statist' assumes.

DISAPPOINTMENT is expressed by the 'Financial Times,' in London, at the report of a select committee appointed by the South African Parliament to consider means for aiding the low-grade mines of the Rand now "in a parlous position" owing to the increased cost of operation. A contrast is suggested between the "cold sympathy" shown to gold mining as compared with the "generous treatment" accorded to the farming industry in South Africa. Similar comment can be made in the United States, and the reason for the disappointment is the same here as there, namely, that mining is regarded as a speculative business, a gamble that needs no aid from the State because it brings its own, often excessive, reward; moreover, it is connected with shady doings on the Stock Exchange, whereas the farmer is a simple man of Sunday-school character, exposed to the vagaries of the climate and the vicissitudes of markets; he is a noble citizen worthy of a pat on the back, whereas the resourceful gold miner can look after himself rather better than most people. In short, the public is misled by false sentiment, and its attitude is reflected by those in authority, whether at Pretoria, London, or Washington.

COST PLUS has received a well-aimed blow from Mr. Charles M. Schwab. Having been called from the direction of successful shipbuilding for profit to the direction of shipbuilding for the people, on the assumption that he knows how to get ships built swiftly and economically, one of his first acts is to strike at the neat scheme evolved early in the War for limiting profits to contractors by means that fail to limit. The principle of a fixed percentage upon an unlimited cost was equivalent to cultivating profiteers in a hot-house. Mr. Schwab has cancelled the contracts of the Submarine Boat Company, at Newark, New Jersey, which was to build 160 steel ships on that basis. Recognizing the fact that prices have increased since the original estimates were made, a new contract at a flat rate has been substituted, allowing a profit of $50,000 per ship on a cost now forecast at $910,000. Assuming that to be a fair outlay for vessels of 5000 tons today, it appears that Mr. Schwab has saved $6,560,000 in this single case by discarding the 'cost plus' principle.

WE do not apologize for giving five pages to the speech by Mr. Hoover appearing in this issue. It does not deal with mining or metallurgy, it does not refer to the making of money out of mining, and therefore it may seem out of place in our columns; but we shall have grossly misunderstood the mind and temper of our readers if we are wrong in deciding unhesitatingly that, to them and to us, there are today matters more important even than the technology of mining or the business of mineral exploitation. Our main concern is to further the great Cause to which as a nation and a people we are committed, namely, to break the onslaught of scientific savagery, to defeat the designs of an unscrupulous autocracy, and to frustrate the ambitions of a military caste without the sense of honor. So we are glad to be able to give further publicity to this most interesting speech by the head of the Food Administration. Moreover, we of the mining profession are proud of the work Mr. Hoover has done in Belgium and is

doing now at home; we are keenly interested in anything he has to say about his work and we wish continually that he may be granted the good health required to direct it successfully to the very end—peace—for which we pray only on the condition that it shall mark the accomplishment of our purpose.

IT would enormously facilitate the development of mineral deposits, especially those capable of yielding some of the minor metals and refractory materials, and it would encourage many chemical industries, if classified lists of the substances controlled by the various committees at Washington were made public. As matters now stand the owners of mineral deposits, or those who discern the opportunity for some useful enterprise based upon accessible raw materials, are not able to ascertain readily the proper bureau or committee to address for the purpose of offering their supplies to the Government. As one committee-man recently wrote to us, "the same group of mineral substances may be dealt with from slightly different viewpoints by four or five of the organizations listed." Lack of co-ordination between the committees often makes it extremely difficult to find where a particular product is needed. A Joint Information Board exists, but as a directory it is confessedly deficient. The Overman Act is meant to bring order out of the confusion by a re-distribution of jurisdiction on a more rational plan, but it would seem to be relatively easy for each department, bureau, committee, and sub-committee to list the raw materials it requires, the uses to which they are to be applied, and the kind of industries simultaneously controlled by the same division, and to report these to the Information Board, where a corps of trained cataloguers could index the data in short order. Monthly indices published by the Government, and made accessible at every post-office, would materially help the people to reach the right officials with their offerings of supplies. Obstacles against such co-operation are useful to the Kaiser and must be overcome.

THE free-born American, with his insistence upon the invincibility of native talent, was an interesting product of the forceful epoch of the pioneer, but he is destined to disappear before the demand for another sort of talent, trained in the use of intellect to achieve results in accordance with the experience and understanding of the past. The Government, for example, has instituted a course of instruction in the principles of industrial management. This, we need hardly explain, has nothing to do with high finance; it pertains to the successful management of men, the application of recognized principles of labor economics, of industrial organization, management, and statistics. It is not a little singular that a nation so insistent upon a universal common-school education for its children, should have developed a widespread scorn of higher training in the great field of commercial and manufacturing enterprise. Business men have insisted on the old blundering way of the empiricist. Experience is a good teacher, but it is slow and hard, and in the end it is narrow. The knowledge accumulated by our predecessors, sifted, collated, and set in order, becomes science, and this can be taught. A student equipped with that science is prepared to adjust himself to the correct course of human activity in any sphere more readily and usefully than one lacking such mental discipline. Mr. Henry P. Kendall, the chairman of the Committee on Industrial Relations, quotes an official of the Industrial Service section of the Ordnance Department as having said recently that "no labor difficulty has been brought to the attention of the Department that could not have been foreseen and avoided if the factory in question had already established a modern employment department." The course now initiated by the Government, because of its discovery that the average manager trained in the old school of empiricism is lacking in competency, started at the University of Rochester, in New York, last March, when 20 prospective employment managers were sent, by manufacturers having war-contracts, for a six-weeks intensive training in the theory and practice of these functions. The work is endorsed by the Educational Committee of the General Staff of the War Department and the War Industries Board. The need for special training was discovered when it became necessary for men to deliver under stress what the best disciplined brain should do under normal conditions, and the average efficiency proved to be low. It is another of the signs of that awakened and proficient type of American whose influence will be supreme in the more disciplined days after the War.

Taxation and Risk

The readers of this paper will share our pleasure in publishing a letter from Mr. H. Foster Bain, now co-adjutor to the Director of the U. S. Bureau of Mines, especially when he writes on a subject of such timely interest as the incidence of the excess-profit tax on mining enterprise. It will be noted that Mr. Bain anticipates an amendment of the law bringing it more in harmony with the conditions governing the actual profit earned in mining. Apparently it has needed an excessive taxation to bring home a recognition of the fact that a mine is a wasting asset and that dividends are not 'income' until the capital expended on the mine has been redeemed. If promoters and directors choose to talk of mines as 'investments,' to regard dividends as 'income,' and to allow share-gamblers to place what is often a misleading valuation on mining property, it is no wonder that the tax-collector, anxious for revenue, has taken them at their word. At the same time it must be allowed that there is a considerable portion of the public that has become thoroughly sophisticated in these matters, so that the share-valuation of some of our big copper mines is close to the present value as determined by experts. The discussion of mining finance precipitated by the proper inquisition and the legitimate taxation—for war purposes—of mines by the representatives of the Government should do great good in educating the public, if, as we insist, make-believe of any kind is detrimental to a civilized community. The wording of the Act imposing the excess-profit tax is vague, if

not contradictory. Apparently it is assumed that a man can look at a mine and determine its value as readily as a real-estate dealer can appraise a city building. Moreover, the law indicates that valuation should disregard profit, keeping an eye only on the assets. Some mine-operators, who have done their best to comply with the requirements, have taken the ore tonnage, gross value, the price of the metal produced, and the cost, therefrom deducing the profit. Taking the estimated life of the mine, they have used Inwood's tables to arrive at the present value of the property. The law says that the 'en bloc' value of the ore as on March 1, 1913, is to be the basis of taxation, and from it the value of plant is to be subtracted, in order to arrive at the value of the ore. It is even practicable to apply the figures of ore extracted backward since March 1, 1913, and therefrom arrive at the 'en bloc' value at that date. Mr. Bain asks "What is the risk-rate in mining?" He desires to start a useful discussion on the subject. We invite our friends to come forward and express their views, so that the ideas of the profession may be unified and then submitted to the authorities at Washington. By a fortunate coincidence we are enabled to publish a thoughtful article on the valuation of mines by Mr. W. W. Whitton, who analyzes the formula brought forward many years ago by H. D. Hoskold, one of the first writers on the subject to recognize the necessity for setting aside a part of the dividend from a mine to provide a sinking-fund that will return the capital when, at last, the mine is exhausted; in short, that the capital put into a mine is a loan, to be repaid with interest. If this view be accepted, it is wrong, says Mr. Whitton, to require a mine to pay during its entire life a high rate of interest on the whole amount originally used. As a matter of fact, those financially interested in mines are not 'investors,' with rare exceptions, but 'speculators'; that is, they buy not to hold until the mine is exhausted, but to sell when the share-quotation affords a satisfactory profit or when they obtain information that the end of the mine is in sight. To such speculators the raising of the dividend-rate is an index of the probable market for the shares and not an increase of income from an investment. The main difficulty of taxation, therefore, is the fact that the proprietary, that is, the shareholders in a company, represents a fluctuating entity, changing from year to year. The shareholders that subscribed to the working capital may have sold out before the mine began to pay dividends, and the shareholder that was in the company during the prosperous years of the mine may have liquidated his holding before the arrival of the lean period that precedes exhaustion. A large risk is inherent, because mining is hazardous, particularly the exploitation of small masses of high-grade ore, such as those of gold and silver. The persistence of an orebody is always doubtful except as far as it is actually proved by mine-workings or bore-holes, but the continued persistence of ore is commonly assumed in the share-valuation of a mine, and usually with an optimism not justifiable by experience. It is a brutal fact that more money has been lost by the public—to insiders—by speculation, or 'investment' as it is usually called, in the richest and biggest mines than was lost in a score of wild or fraudulent ventures that proved miserable failures, as mines, whatever success they may have had as counters for a gamble. There are two risks to be faced, the first is the proportion of net profit to be won from ore that is 'proved,' and the second is the probability of finding more ore. The attractiveness of mining depends usually on the second factor; when mining rarely does come down to a safe 'investment,' it is then no more attractive, to the intelligent speculator, than municipal bonds, preferred industrial stocks, or any other form of gilt-edged security. Formulas for expressing the probabilities of ore-extension in depth have been submitted to the mining profession from time to time, but they excite no special interest, because the experienced engineer knows that they are unreliable. No formula can cover the unlimited variability of the principal factor in the problem, namely, the eccentricity of ore deposition. Consider a small, but rich, gold mine, at Cripple Creek, for example, that is paying 25% on its share-capital, with the assurance of not more than one year's life. As a rule the richer the mine the smaller its proportion of ore in reserve. Then consider a mountainous mass of low-grade copper ore, such as that at Bingham, assuring operations for 30 years, provided the price of copper remains at a given figure. Allowing for the smaller fluctuation between the values of gold and of copper, as expressed by the index-price of staples, there is still a manifest difference in the risk inherent in the gold-mining venture as against the copper-mining enterprise. A risk-rate of 50% might not be too large for the one and 10% might not be too small for the other. These are some of the considerations pertinent to the question submitted by Mr. Bain; we hope to elicit a useful discussion on the subject.

Price-Fixing of the Minor Minerals

Mr. Pope Yeatman, head of the Non-Ferrous Metals Section of the War Industries Board, is not satisfied with the War Minerals Bill as it left the House. He appeared before the Committee on Mines of the Senate and insisted that the power to fix prices be re-instated. This conforms to the view we have presented. The authority of the War Industries Board over the matter was explained in these columns last week. It gives, not a power to fix, but the privilege of reaching an agreement with producers, after a roundabout tedious process of investigation and recommendation from bureau to bureau, ending in a price that will last only until changed by a new arrangement. It lacks the value of finality; for men of small means cannot risk their all in a mine when they cannot depend upon the market. The gentlemen of the House of Representatives seem not to understand the peculiarities of the deposits of many minerals specified in this bill. They may derive their ideas from the mining law, which is based on the conception of tabular veins, like the ham in a sandwich. If orebodies were only tabular in form and uniform in metal content there

would be no need for this bill. The truth is they are not even veins, as a rule; they are erratic irregular masses, variable in size and richness. The dead-work is usually enormous in proportion to the ore developed; a pocket or patch of wolframite may, and may not, pay for the work to be done through barren ground to reach another pocket; chrome is segregated from basic rocks into isolated patches from the size of an egg to that of a freight-car, but usually a mass that yields a few hundred tons is regarded as satisfactory. Under such conditions the development of large tonnages is next to impossible. The occurrence of manganese is not so irregular as that of tungsten or of chrome, yet large and continuous ore-bodies of merchantable grade are uncommon. The cost of production of most of these minor minerals is far higher than of those that can be systematically developed and mined on a large scale. The risk is proportionately greater. Either the Government must finance such mines or must guarantee a reasonable price for a definite period, otherwise no adequate increase of output is to be expected. This is a war-emergency measure, and unless it carry the power to ensure a market the desired stimulation will not be experienced; it is not enough to provide for making contracts unless the authority to contract can be delegated to local officials, because the majority of those whom this bill is meant to energize into producers cannot afford to go to Washington for negotiation nor to employ the professional talent necessary to prove that they possess anything worthy of consideration. If the Government were to contract with every applicant on the strength of his unsubstantiated assertions a new crop of grafters would be hatched to fatten on the sale of stock in bogus undertakings. The power to fix the price for a definite period, and to accept all the material offered within that period, is worth infinitely more than the authority to contract. The financing of such mines will be done by the public readily enough under these assurances. Mr. Everett Sanders, of Indiana, and other Representatives, argued that such provision might so stimulate production as to embarrass the Government with large stocks that it could not use. Mr. Courtney W. Hamlin of Missouri suggested that the output would go mainly to those engaged in manufacturing war-supplies, which is true. The guarantee applying to materials needed under the present exceptional conditions is the thing that is urgent; it is the prospect of loss in the event of an early cessation of this extraordinary demand that is to be averted. To do this might throw a responsibility upon the Government to purchase a few million dollars worth of minerals at a higher price than it could realize afterward in the market. What is the risk of such a loss to the nation as a whole, compared with the probability of being retarded in the production of munitions for effective warfare against the barbarians? The debate in the House developed the conviction that a number of large mining concerns were already able to produce manganese and other minerals in considerable quantity, and that no further powers were required, because the means of financing through the War Finance Corporation in conjunction with the power to contract exists already. In this we detect the opportunity for profiteering. Many small miners would be prevented from making their contribution to the total output; the supply would be inadequate; and the large producers could then obtain higher prices than would be necessary if the Bill in a broadly equitable manner, without discrimination or favoritism, opened the door to poor and rich alike.

Postal Exchange With Mexico

Many of our readers will be pleased to learn that the resumption of exchange by international money-order with Mexico has been authorized by our Government. Such relations have been suspended since October 1909. While the revolution was at the boiling-point every semblance of orderly government was dissolved; and to cash money-orders would have been like flinging good money into the sea. Since the recognition of Carranza's government, however, our failure to remove the restrictions upon this kind of exchange has been much more than a commercial disadvantage; it has served to restrain the development of cordial personal relations between Americans and Mexicans. There is a value to commerce beyond the mere financial gain involved in it. Men grow to like those with whom they have pleasant trade relations; a Mexican who orders a watch or a pair of shoes from an American advertiser, and is pleased with the article that is sent to him, feels more kindly to all Americans. He who orders a book from Mexico learns something of the warmth of that southern blood that is bad mainly when incited to evil by malicious leaders. It is the many small business transactions, which have the effect of encouraging genial relations between man and man, that the postal exchange chiefly stimulates; it has a profounder influence on the people than larger operations liquidated through the banks. The movement of sisal and of lead ore to the United States, and of corn and sugar to Mexico, negotiated by effecting trade balances in the clearing-houses, fails to engender the sentimental feelings that are at the bottom of international goodwill. Whatever tends to strengthen the ties between ourselves and our neighbors should be sedulously cultivated. In this connection it may be noted that easy exchange in small articles between the United States and Spain has been rendered impossible ever since the Spanish-American War because the facilities for exchange through the Post-Office have been suspended. It is time that this barrier were removed, and we believe that the diplomacy of Ambassador Willard could accomplish it. If an American wishes to subscribe to 'Blanco y Negro,' or to purchase a clever Barcelonan knitting-machine for domestic use, how will he send the necessary driblet? He must go to his bank and buy a draft on London or Paris. When the book is worth only 90 cents the case becomes ridiculous. The result is that the money is not sent, and one more American is cut off from helping his country through getting a little closer to a Spaniard and thereby awakening a cordial interest each in the other.



Excess Profit and Mine Taxation

The Editor:

Sir—In your editorial of April 27 on the War Minerals Bill, you bring up a point of first importance; one touching on the necessities of war taxes on mines. An amendment has been submitted to the bill now before Congress which if adopted will relieve the new properties called into being to meet this emergency from the excess-profit tax. This, it will be recognized, is a matter of first importance since many of the particular properties in view will be short-lived and it would be impossible to get them opened up if the usual construction of the tax law is to be applied to them.

It is probable that a serious attempt will be made to amend the general income and excess-profit tax law by this Congress. In that connection there are two points on which it would be helpful to have discussion with mining men. The first is the depletion charge to cover exhaustion of ore-reserves. For my own part, I anticipate no serious difficulty here, since the existing law recognized the fact that depletion may be charged, provided that it is not larger in any one year than the gross output. This is as much as mining men have a right to expect. The difficulties here will be in the fact that money spent on development often results in the bringing into the reserve of orebodies of a principal value largely in excess of the development charge. If this was not so mining would not be profitable. With better companies this excess value is promptly shown in the share-value, but under the existing law and interpretation, it would not be taken into account in taxes. In other words, depletion charge could only run against the amount charged for development. The net result of this is to value a mine differently for taxation purposes than for market purposes, and so the investor may actually pay for his shares more than he can ever get back from depletion. There is probably no injustice here, but it is a point which should be appreciated and taken into account when anyone buys shares.

The second point is: what is the risk-rate in mining? If it be assumed that a tax law be so drawn as to cover satisfactorily the principle of wasting assets as applied to mines, this still only takes care of the successful property. In mining and in oil-production, it is necessary to spend money on a large number of prospects in order that one may be found that by its success will cover the losses on the others. Some way the profits in the industry must be large enough to cover this charge or production will cease. This is a legitimate risk and should be taken into account in fixing the return which will be allowed to mining companies before the profit-tax is applied. So far as I am aware there is no concensus of opinion as to what this risk-rate is. It would be very helpful to have expressions of opinion from engineers, and particularly any tabulations as to what the actual cost in money has been which has gone into properties of average success. In getting out these figures it should be remembered that other industries have risk-rates and that this is not a problem peculiar to mining. At times we deceive ourselves by thinking that a manufacturer or a merchant has always an established and growing business and that the risk element has disappeared so far as he is concerned. A little study will show that this is wrong. The rate in the business may be different from that in mining, but it is there, and the helpful thing will be to find out what the real risk-rate applied to various industries is so that it may be used in determining the incidence of taxation. If you will take the lead in stimulating a discussion along these lines, your action will, I am sure, be appreciated by Washington authorities.

H. Foster Bain.

Washington, May 4.

Flotation of Semi-Oxidized Silver Ore

The Editor:

Sir—E. J. Atckison's article on this subject in your issue of April 27 gives to the public some interesting data concerning the use of gasoline as a reagent in flotation, and, as Mr. Atckison calls it, "a substitute for acid." He states also that while the function of the gasoline is doubtful, the idea is that it cleans the oxidized mineral and allows the sodium sulphide to act upon it. Does he mean that it removes the oxide film? Several times I have resorted to the use of gasoline as an additional reagent, but I am inclined to believe that its function is to remove films of foreign oils and greases only.

I am very sorry that Mr. Atckison did not preface this article with a description of the ore. I believe that most writers have not given enough attention to this factor. In all of my work, I have found that the mineralogical composition of the ore, and particularly that of the gangue, is the factor governing the use of reagents, and to a greater extent, the use of various oils.

Acid is not always necessary in floating semi-oxidized ores. Various experiments I have made have proved this. Often, by the addition of acid, the grade of concentrate will be improved, but the amount of valuable

mineral (gold, silver, galena, or whatever is sought) will be the same in both cases.

A short time ago, in an attempt to repeat some work on a galena-limestone ore, my first attempts were failures. Upon examining the container (I was using a ready-mixed pulp) I discovered that some oil from an overhanging shaft had dripped into it. The addition of 0.1 cc. of gasoline to 2000 cc. of slime immediately remedied the condition. In this particular ore, acid had always proved detrimental, and the gasoline therefore was not a substitute.

On another ore, for which acid is decidedly necessary to hold back finely divided sericite, the substituting of gasoline for acid was a complete failure. The froth carried only a trace of the value. Additional sodium sulphide (the ore was partly oxidized) seemed to improve conditions slightly, but the best recovery I could make was only 40%, where a 90% recovery was possible with acid.

L. B. PRINGLE.

Bonne Terre, Missouri, April 29.

[Mr. Pringle makes a good point when he insists that every article on metallurgical results should include a detailed description of the ore.—EDITOR.]

Nitrate Lands in Chile

The Editor:

Sir—Your New York correspondent of March 23, 1918, announces the advertisement in the New York papers of a sale by auction, on August 10 next, of 9,906,402,886 metric quintals of 'nitrate land' in Chile, and comments upon the fact that the sale of about a billion tons of 'caliche' suggests some more ambitious scheme for the treatment of the material, etc.

Nine billion quintals at an average of 23 centavos (at 18d. per peso) each, as stated by him, make a total of $820,000,000 U. S. currency, so that if we average the 14 lots into that amount, the average price per lot would be over $58,000,000; and as auctions for nitrate lands in Chile are conducted as are other open auctions, except for the rule that a certificate of deposit of 10% of the minimum purchase price must be presented by each bidder before entering the auction, one can picture this auction as on a truly regal scale, each bidder having made his deposit of about $6,000,000 in cash and the bids advancing five to ten million dollars at each raise.

Anyone familiar with the nitrate industry, however, knows that the Government has explored no such extent of nitrate lands; moreover, that it is the policy of the Chilean government to sell the lands in relatively small lots to encourage competitive bidding.

It happens that most of the lands for sale are lands which were carried over from the auction of September last, when nobody made a sufficiently high bid to buy them. A perusal of the Government estimates and sampling-lists published at that time, shows that in the advertisement now published, seven out of the fourteen lots have a decimal point changed to a comma followed by a zero. For instance, the San Juan de Soledad lot, which in the estimates prepared by the Chilean government is given as containing 2,546,826.26 quintals, has become in the advertisement in the New York papers, 2,546,826,026 quintals, or 1000 times greater. The same error occurs in six other lots.

The metric quintals advertised refer to nitrate content and not to caliche as supposed by your correspondent. Moreover, they are the net nitrate yield of the ground as estimated by the Chilean government engineers.

The statement that "Payment is to be made at a standard rate of exchange of 18 pence (36 cents) per peso," made by your correspondent is also wrong. Such sales are always in Chilean gold pesos, which at par are worth 18 pence sterling. Recently they have been quoted at somewhere about 21 pence (42 cents) per peso.

HUNTINGTON ADAMS.

New York, April 29.

[This is a good example of the errors arising from the unnecessary use of the decimal point. To say that the land contains 2,546,826.26 quintals is a specimen of the meticulous precision that really says nothing more than 2,546,800, but invites either misunderstanding of the method of estimation or leads to typographical blunders of a gratuitous kind.—EDITOR.]

Solubility of Wolfram

The Editor:

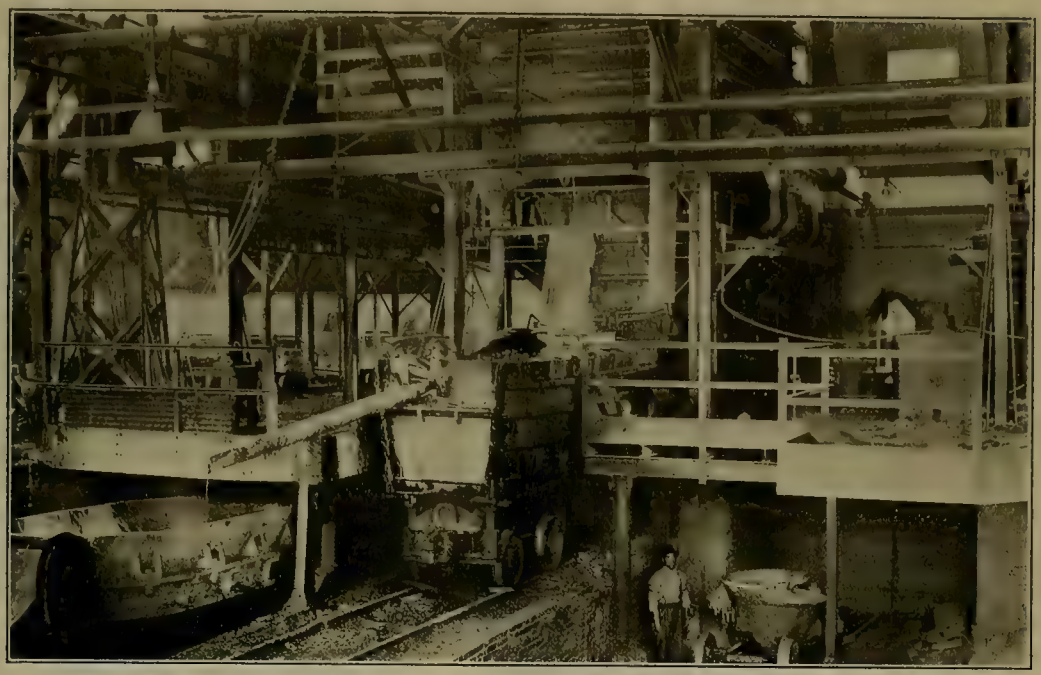
Sir—In your issue of December 8, 1917, there is a reference to the solubility of wolfram. I recently discovered in India a wolfram-scheelite deposit where there was apparently a most rapid decay of the wolfram, pieces of bright wolfram forming the kernel of masses of gossan or friable lumps of iron oxide. There was absolutely no trace of detrital wolfram in the neighborhood of the lodes. The deposit was in quartzite and associated with apatite and molybdenite.

PHILIP E. BILLINGHURST.

Calcutta, March 5.

GRAPHITE PRODUCTION of the island of Madagascar, East Africa, in 1917 was 35,000 tons, a gain of 4500 tons. Stocks there at present amount to 15,000 tons. The U. S. Consul at Tananarivo states that there has been recently a considerable slump in the prices of graphite on the local market. First-quality material, averaging 90% carbon, which a few months ago brought 750 francs ($144.75) per ton, brought only about 500 francs ($96.50) toward the end of February 1918. On the other hand, because of the general situation of the graphite market, few offers are being made locally for the purchase of this mineral.

TIN recovered by dredging in Siam during 1917 amounted to 6,306,000 pounds. There were 16 boats operated, against one in 1908, digging 10,000,000 cu. yd. of tin-bearing ground. The yield last year was from 0.60 to 1.16 lb. per yard. The black tin (SnO_2) is reduced to metal at Singapore, and enters the trade as Straits tin.



ARRANGEMENT OF SETTLERS AND SLAG-CAR AT LEAD BLAST-FURNACE

Smelting Methods at El Paso—I

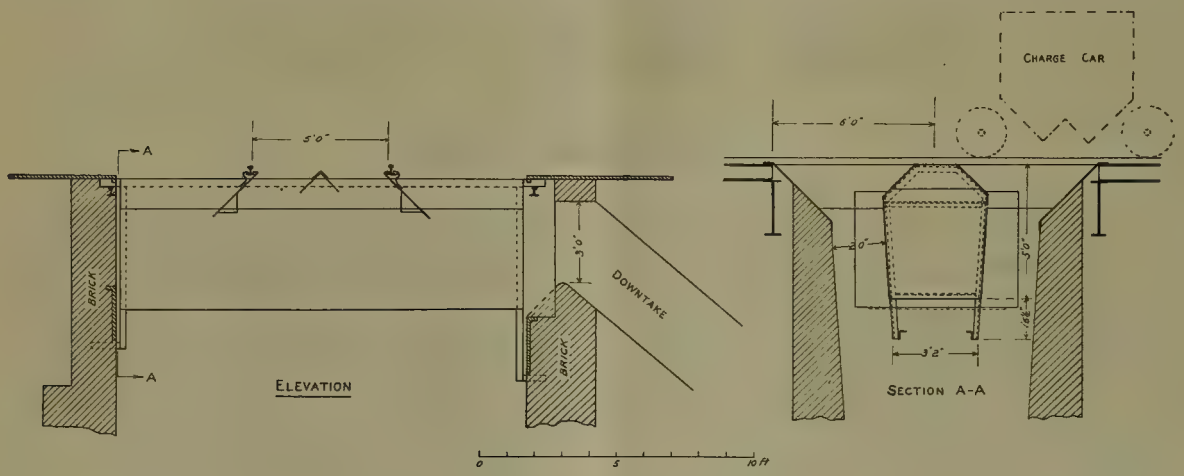
By COURTENAY DE KALB

Smelting practice never long remains stationary. Changes in the character of the ores available, new methods of concentration, and the urgency of the market-demand, introduce new problems and these must be met by modifications of previous methods. At the plant of the Consolidated Kansas City Smelting & Refining Co., at El Paso, important developments since the interesting paper by H. F. Easter, in the Trans. A. I. M. E. in 1915, give pertinence to a new discussion. This plant for many years treated a great preponderance of lead ores. It depended fundamentally upon deliveries from Mexico. The revolutions in that country shut off the supply altogether for a time, and the interference both with mining and with shipment is still serious. At present the total receipts of Mexican ore average about 150 tons per diem, most of which is from the Potosi Mining Co., operating in the Santa Eulalia district, Chihuahua. Meanwhile the war-demand for lead encouraged smaller shippers throughout New Mexico and Arizona, and the diversified offerings have exaggerated the heterogeneous composition of the ores from which the mixtures are made. The El Paso smelter, moreover, treats the total output of flotation concentrate and ores from Chino, and thus a distinctive character of the plant, as one in which lead and copper metallurgy overlap, is still maintained. One of these days a brand new plant will be built, but until then the staff confronts the interesting and difficult problem of meeting the demands of economy in competition with newer plants by careful management and by modification and improvements of the old equipment. The El Paso plant is a meeting place of appliances representing a long epoch of metallurgical history, and at the same time it is a leader in the march of progress. This is a record that reflects high credit upon the staff in charge. Starting with a Godfrey roasting-furnace that dates back over 20 years, and ending with the adaptation by Philip S. Morse of the hooded lead blast-furnace, it will be seen that the El Paso works present features of no common interest.

The Godfrey apparatus is of the turret type, recalling the methods of a generation ago when the mechanical roasters were in process of evolution toward the perfected models of the Wedge, McDougall, and Herreshoff of the present day. Unlike the Pearce turret, which introduced the circular hearth with revolving arms, the hearth itself revolves, while the plows are stationary, being wrought-iron strips bolted to a heavy casting, which is built into the roof, uncooled except for a slight

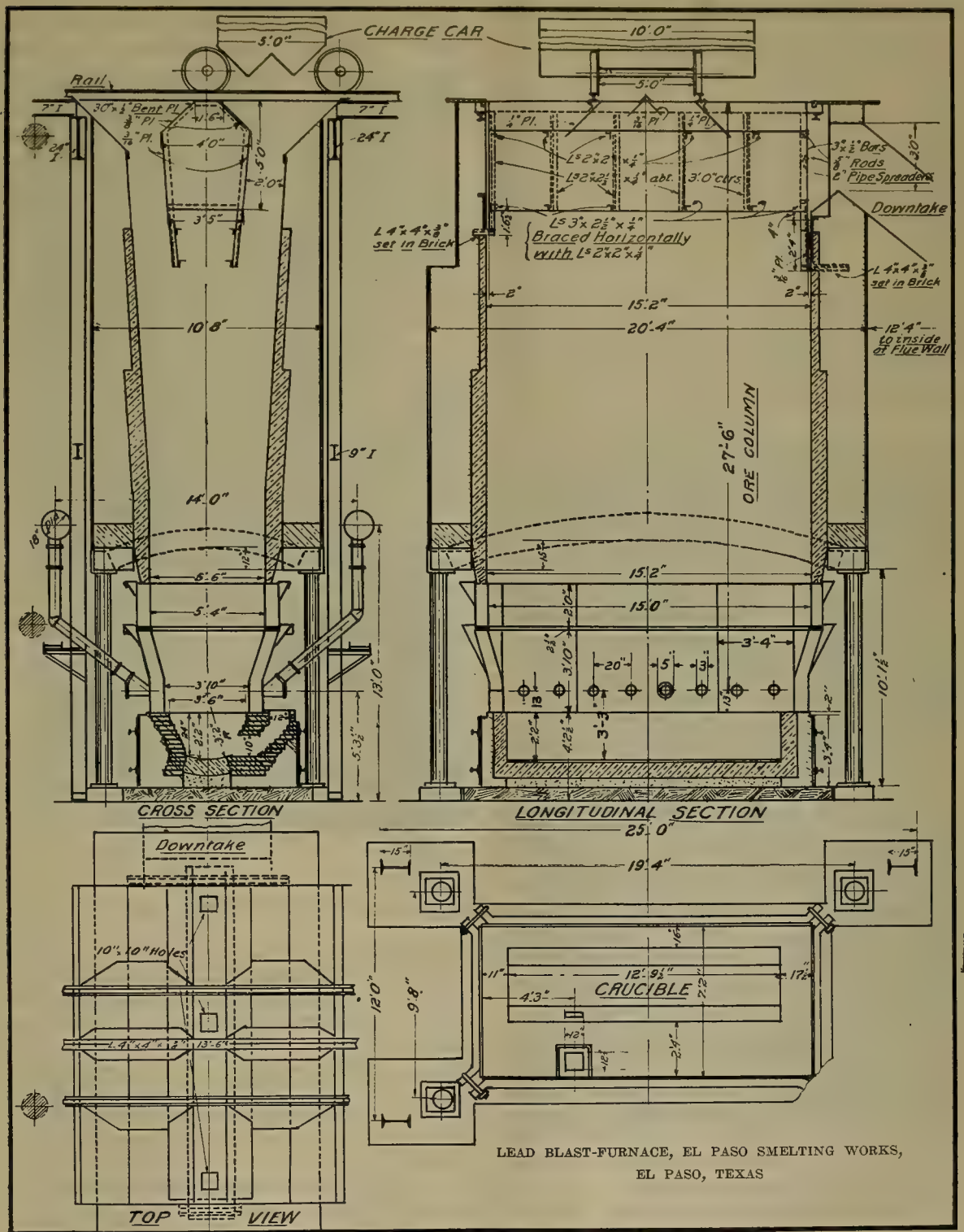
air-leakage. It has a single hearth, 26 ft. in diameter, supported upon six wheels near the periphery. In spite of the great weight to be moved, it requires only five horsepower, and it desulphurizes 30 tons in 24 hours. The three Godfreys in the plant are driven from a single line-shaft. The rate of travel is one revolution in two minutes. Each furnace is fired at two points, the fuel being chiefly crude oil from which a portion of the volatile compounds has been distilled. The average consumption of oil is about 400 to 500 bbl. per month for the three roasters. The charge consists of highly sulphurous leady material, and may be a mixture of ores, concentrates, and matte, especially such as contains considerable iron sulphide. The object of treatment in these machines is merely that of pre-roasting in preparation for subsequent roasting and sintering in the Huntington & Heberlein pots; hence the average work is done to reduce a sulphur content of about 18% to a residue or calcine containing 12%.

There are eight of the H. & H. pot-roasters in the plant, set at an elevation of 8 ft. above the ground in a steel-framed structure. The cast-iron pots are eight feet in diameter at the top, drawn in at the grate to a diameter of six feet. The grates are castings ½ in. thick, made in segments. Holes ¼ in. diameter and 1½ in. apart are cast in the segments. Over each pot is a stationary circular hood, and the hoods connect with a down-take flue. It should be stated that one of the Godfreys has a fire-box for burning ordinary run-of-mine bituminous coal. This condition results without special prevision, since the materials as offered in the routine business of the smelter contain such a desirable excess of iron. It should be noted, however, that experience here and at other plants has shown that in roasting lead ores it is essential to have considerable silica present to reduce the loss of lead in roasting. Equal proportions of lead and silica would not be amiss. It has been held generally that the function of the silica was to form a silicate of lead, thus preventing the lead from being reduced too easily and thereby limiting the loss by volatilization; but another item has to be considered, namely, that in roasting lead with iron, mainly in the form of sulphide, the proportion of sulphur might readily become so great, if no silica were present, that the temperature in roasting would rise too high, in consequence of which the presence of the larger amount of sulphur might exert some reducing action, involving lead losses that would not take place if the excess of iron and its accompanying sulphur were diluted by adding inert silica. Therefore the silica, by reason of its inert character, may perform a useful office in helping to reduce the loss of lead by volatilization. Moisture is added to the extent of 10 to 12%, this being essential to the process of sintering; without it the mass remains granular and will not agglomerate. The function of the water is not definitely explained, but it would appear that it serves, first, to confine the zone of the silicate-forming reaction to a horizontal layer that advances up-



OUTLINE OF DRAFT-HOOD FOR LEAD-FURNACE

is maintained with special reference to the operation of the H. & H. pot-roasters. When ready to charge a pot some of the coal from the Godfrey is brought alight and dropped upon the grate, covering it to a depth of two inches. Upon this is fed calcine, also from the Godfreys, dampened and mixed with fine material that needed no preliminary roasting. A charge consists of 11,000 lb. The average sulphur in the material fed to the pots is 12%, and there is a considerable excess of iron over the silica present. This serves to protect the lead against forming a silicate, and it happens that this advantageous ward through the mass, reaching a temperature of about 1100°C. at which the iron will combine with the silica, and, second, to absorb heat just above this zone by vaporizing the water, thus preventing an increase of temperature that would result in fusion. If unrestrained in this manner, the charge, being shallow, would be subject to the conditions of heap-roasting, the heated gases would escape through channels, a small amount would be slagged and matted, and the remainder would tend to disintegrate. As the operation is conducted the product becomes a porous well-agglomerated mass, containing 3



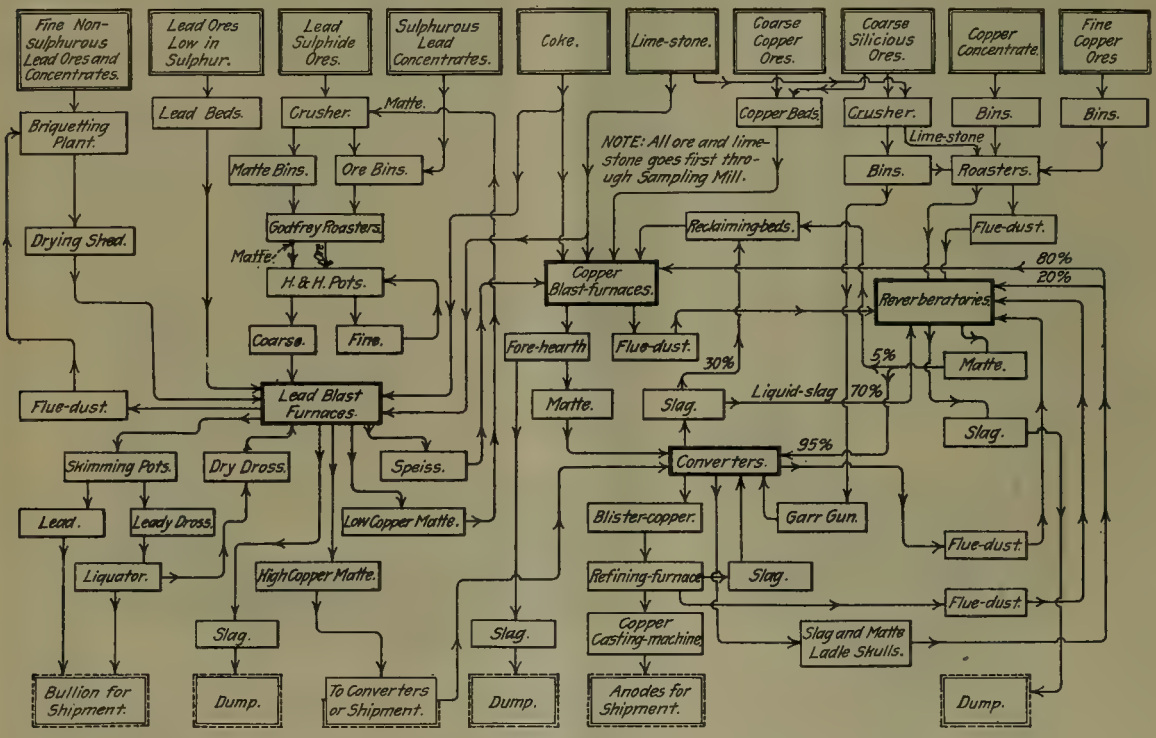
LEAD BLAST-FURNACE, EL PASO SMELTING WORKS, EL PASO, TEXAS

to 6% of sulphur. The analysis of the material, after combined Godfrey and pot-roasting, varies greatly from day to day, but the following examples are representative:

Analyses of Roasted Lead Ores, El Paso Smelter

	A	B	C	D
	%	%	%	%
Lead	11.8	20.6	30.0	8.5
Copper	3.0	5.0	1.8	15.0
Silica (SiO_2)	33.8	12.0	13.6	9.0
Iron oxide (FeO)	19.1	27.6	24.3	43.0
Manganese oxide (MnO)	1.0	0.6	0.7	0.5
Lime (CaO)	2.9	2.4	1.5	2.1
Zinc	8.8	6.5	6.5	2.5
Sulphur	3.8	6.3	6.2	4.0

a side, 3½ in. diam., delivering blast under a pressure of 3½ to 5½ in. mercury-gauge. The hearth-area at the tuyere-level is 46 by 162 inches. The furnace-base is of brick, 7 ft. 2 in. by 15 ft. 5 in. inside the crucible-plates. The latter are 3 ft. 4½ in. high, supported on a steel pan. The crucible is 2 ft. wide at the bottom, and 3 ft. 6 in. at the top; 12 ft. 9 in. long, and 2 ft. 6 in. deep. The lead-well is 12 in. square, but the Arendt-tap is apt to freeze up because of the large amount of copper in the bullion. Accordingly the separation of the products of smelting is effected almost wholly in large fore-hearths or settlers. These are somewhat unusual in being made of cast-iron about 1½ in. thick, and in being unlined. The settler nearest the furnace has about six inches of slag poured



FLOW-SHEET OF EL PASO SMELTER, CONSOLIDATED KANSAS CITY SMELTING & REFINING COMPANY

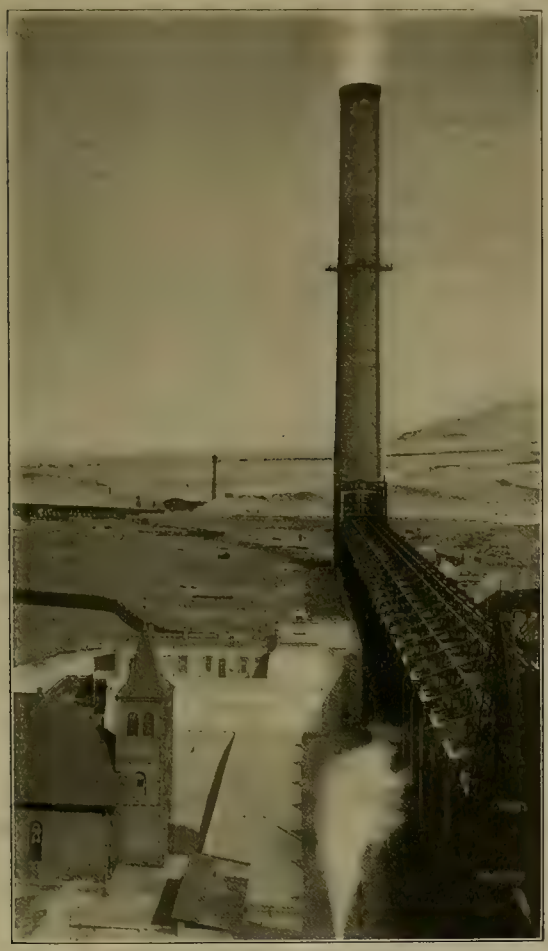
The crushed matte is roasted in the Godfreys, sintered in the H. & H. pots, and then charged in a blast-furnace devoted solely to concentrating matte.

The oxygen taken up in roasting roughly balances the sulphur eliminated, so that the weight and relative proportions of the constituents are not altered. The charge is dropped from the pots to a floor 8 ft. beneath, which breaks most of it to the proper size for the blast-furnace. The larger chunks are broken with sledge hammers; automatic appliances for handling and preparing the ore and other materials not being used to any extent.

Six blast-furnaces constitute the full lead-smelting equipment, but usually no more than five are in operation. These are 32 ft. high, smelting a charge-column of 19 ft. The lower water-jackets are 4 ft. high and the upper are 2 ft. Each furnace has 16 tuyeres, that is, 8 to

into it before being put in service; this is to protect the bottom plate from the matte; a few bricks are also placed behind the matte-tap plate; otherwise the settlers are without lining. Their size, moreover, is not large, namely, 8 ft. 2 in. by 4 ft. in horizontal section, and 4½ ft. deep. Each settler is mounted on wheels, so as to be easily removable when repairs are needed, and it is provided with two tap-holes at different levels for drawing off the lead bullion and the leady copper matte, respectively. The slag, still containing some entrained metal, overflows into a second settler, the function of which is to afford a quiet pool of slag where the remaining matte may settle. When the settler freezes, so that this pool has become reduced to a small size, a new one is put in its place, the old settler being taken to the rip track, where the sides and ends are removed, and the

frozen slag dumped as a solid mass. This is broken and returned to the furnaces as foul slag. Nothing is ever tapped from the second settler; the slag merely passes into and overflows from it. If zinc is present in great abundance it may chill in 24 hours. The slag assays



STACK FOR COPPER-FURNACE FUME AT EL PASO SMELTER

about 1% sulphur, 0.20 to 0.45% copper, and 1 to 1½% lead.

A comparison of a typical slag-analysis with the flue-dust representing recovery from gases issuing from the lead blast-furnaces will be interesting:

	Flue-dust		Slag
	%	%	%
Lead	17.4	14.8	0.90 to 1.50
Copper	2.0	1.5	0.20 to 0.45
Silica	17.0	18.3	32.50
Iron (FeO)	30.0	26.0	32.80
Manganese (MnO)	1.0	1.3	2.00
Lime (CaO)	7.0	6.5	22.00
Alumina (Al_2O_3)	...	...	3.80
Zinc	3.1	3.2	4.00
Sulphur	2.3	2.9	1.00
Arsenic	1.0	1.0	0.35
Silver, ounces	14.8	20.0	0.50

The matte drawn from the first settler contains approximately 10 to 25% of copper, 14% of lead, and 21% of sulphur. The proportion of copper varies with the ores received, and for the sake of the crucible it is desirable to keep it low. This matte is cooled, crushed, and returned to the Godfrey roaster, thus remaining in the lead-smelting cycle. The slaggy matte from the second forehearth, however, is of variable composition, sometimes containing much lead, in which case it is returned to the lead-cycle, but when it is low enough in that metal so that the recoverable fraction would cost more than its market value it is sent to the copper converters, where the copper goes into blister and the lead is volatilized. The grade of matte from the lead department that is either shipped or sent to the converters is what comes from a furnace smelting roasted matte exclusively, and it is the only matte produced by that furnace. This matte is caught in and tapped from the first settler, the same as if the furnace were working on ore. If high enough in copper and low enough in lead it is treated in the converters, the lead in that case being volatilized, but if the lead content is too high it is shipped to some other



SLAG DISPOSAL AT LEAD BLAST-FURNACE

plant prepared to save the lead. The lead-furnace that is concentrating matte, which may be any one of the battery of furnaces, produces a 40% copper-matte.

The lead-furnaces each smelt on an average 145 tons per day, and to this is added about 15 to 18 tons of coke,

which is fed in separate layers between the successive charges of 7400 lb. each of the bedded ore-mixture. The average 'mix' carries 10% lead and 1½% sulphur. The feeding is done by bottom-dump cars running on a 5-ft. track, and operated by an electric motor. The charge is dumped directly over the top of the furnace, which is entirely exposed and unprotected and at the same time absolutely fumeless. Here is one of the most interesting improvements in the plant. Copper smelters will recall an attempt to achieve the same result many years ago in Europe. This was by means of a series of tubes, sometimes made of cast-iron, sometimes of cast blue-metal or blister-copper, placed in a row along the central horizontal axis of the furnace and extending to a depth of several feet below the upper level of the charge. It gained no currency in American practice, where the tendency was toward fast driving, which meant running with a hot top. Nevertheless, it was impossible not to be impressed with an inherent merit in the device. I was deeply interested in seeing it as applied to the peculiar conditions of copper smelting in the works of the Cie. du Boleo, at Santa Rosalia, Baja California. The ore there smelted was a mixture of copper carbonates, silicates, and oxides, in a highly argillaceous gangue, which tenaciously retained large amounts of moisture, balling up so as to make masses that would not pass through a 3-in. grizzly. Part of the ore was compressed into briquettes about 3 in. diam., in order to put it into practicable shape for smelting. Through such a mass of damp charge it is evident that only a high blast-pressure and a great excess of coke would have prevented the prompt freezing of the smelting-column without the use of some such device. This apparently solved the problem in a satisfactory manner. The smelter-fume passed through the tubes to the downtake flue, the charge settled evenly, and no gases escaped except a little steam driven off as the heat from below vaporized the moisture. It was thus possible to smelt under favorable conditions of blast-pressure and fuel consumption. The basic principle of this plan, highly improved, and introducing new and advantageous features, has again emerged at El Paso in an adaptation from Australian methods, under the direction of Philip S. Morse, the able consulting metallurgist of the lead department. The method had long been used in central European lead plants before it was applied in Australia. At El Paso it is called a hood. The accompanying illustrations show the elements of the appliance. It consists of a box, closed at the top and at one end, but open to the down-take flue at the other end, and also open below. In transverse section it is roughly thimble-shaped. Cast-iron plates of suitable form, built into the brick shaft of the furnace, support it so that the lower narrow end is 6 ft. 6½ in. below the top. The hood is tapered toward the bottom to correspond with the batter of the shaft-wall, maintaining a space 2 ft. wide on each side lengthwise the furnace. The charge-car is seen centred over the plate covering the top of one wall. The door on the left side is dropped, and, as the charge dumps, the coarser pieces gravitate toward the hood. Thus the greater part of the fine material remains on the outside next to the shaft-wall, while the coarser ore accumulates at the centre, leaving the charge more permeable by the gases directly underneath, and the fume naturally follows this line of least resistance into the hood and thence to the flue. Doors are provided in the top of the hood in order to observe the condition of the charge and to gauge the heat of the furnace. The beneficial results are numerous and important. In the first place no fume escapes from the top of the charge at any time unless the proper burden is not maintained. Inattention on the part of the workmen to charging the furnace when needed results in the escape of smoke because the column settles to the lower edge of the hood; this would soon make the charging-floor uninhabitable, and the only remedy is to feed the furnace. The concentration of the heat in the centre of the furnace tends to reduce the formation of wall-accretions, and the fine ore being kept toward the outside is not in the path of the greater movement of the gases. This has an important effect in curtailing the dust-loss. Moreover, it is found that the coke-consumption is materially less than with furnaces operated alongside, that treat identical ore-mixtures, but are unprovided with the hood.

Under the old method the volume of gas going to the flue was enormous owing to air drawn in above the charge. This dilution is entirely avoided by the use of the hood. Furthermore, under the former system, the temperature of the gases entering the downtake was 300° F., owing to the peculiar ore-mixture smelted at the El Paso works, and no means could be found to reduce the furnace-temperatures until the hoods were installed; then the furnace-temperature fell about 100°, while the smelting-conditions were improved. The one defect that has been disclosed in practice with this appliance is a tendency of the long side-plates to warp, which then permits some fume to escape. This will be remedied by a special form of angle-bar riveted to the sides. It has given such remarkable results that it would not be surprising to see renewed attempts made to adapt the idea to copper smelting.

(*To be Continued*)

LEAD ore imported in February amounted to 2,361,276 lb., against 2,883,657 lb. for the same month in 1917. For the eight months ending in February the imports totaled 22,677,110 lb., against 27,788,213 lb. for the same period in the previous year. Imports of pig-lead, bars, and old lead for eight months ending in February were 16,346,262 lb., against 7,068,963 in the corresponding eight months of the previous year, and 137,218 lb. in the year before that. Exports of pig-lead, bars, and old lead for the month of February were 20,636,407 lb., and for the eight months 143,862,148 lb. For this period in 1917 the exports amounted to 141,583,242 lb., and in 1916 to 143,203,251 pounds.

Food for the War

By H. C. HOOVER

*The Food Administration is purely a war institution. Its first and primary concern is the feeding of our own people and those of the Allies, and thereby the maintenance of the strength of all men, women, and children, both there and here, and thus the strong arm of our soldiers.

The necessity for the creation of Food Administrations in all the countries at war with Germany arises solely from the situation in overseas shipping. Over one-third of the world's carrying capacity has been diverted directly and indirectly to military purposes, and of the remainder there has been an unceasing loss during the War. There is an abundance of food accessible to the seas, but there are not the ships to carry it from every point and to still conduct the War.

The first adjustment of this situation has been to isolate the more remote markets. There are today abundant stores of food in Australia, the East, and in South America. Ours and Canada's are the nearest supplies to the Allies, and better protection from submarines can be given to ships on the Atlantic lane than on other sea-routes.

Roughly, every 5000 tons of food to the Allies requires 15,000 tons of shipping from Australia, 10,000 tons from the Argentine, and 5000 tons from North America. Every steamer we can save from these long journeys means the possibility of an additional shipload of soldiers and munitions to France. If the Allies were compelled to go to these more remote markets for their whole food-supply today it would require over 2,500,000 tons more shipping than at present in use for this purpose. If North America could next year provide the whole of Allied necessities we could have 1,500,000 tons of shipping. Every ship we save is a ship built. The weight of our blow against the Germans will be limited not alone by the ships we build, but by the ships that we save. The measure of ships saved by food supplied directly from North America is, until our shipping expands, the measure of ships for our own soldiers.

If the Allies were forced to rely wholly upon the remote markets for their food, we would have no soldiers in France today. Nor will the burden grow less in the near future, for every ship we build will be needed to replace losses and to increase our army at the front. This is conservation of ships as well as of food. Therefore the whole war-food problem is simply and solely a determination of the amount of food that can be spared from North America; the marginal amount must be drawn from the more remote markets.

From this spring broad administrative issues.

First: the amount of food we can send without injury to our people, and the method of securing it.

Second: the economic measures we must adopt to protect our people from the disturbance to nutrition and commerce by this drain of supplies.

In the daily toil of all these Food Administrations there have grown up new and practical issues in matters hitherto regarded as pure science. This administrative world today views production and the feeding of human beings and domestic animals in a new light. Terms strange to the lips of all but scientists three years ago are now our daily vocabulary. One must now reduce food to its physiological value. In considering the most concentrated and durable forms for overseas transport and for the maintenance of health and strength of populations, we find ourselves constantly reducing all food-material to the three main essences, that is, protein, fat, and carbohydrates. These strange terms are daily being more vividly silhouetted against this background of world tragedy. The European food-controllers anxiously take their stocks, not on the basis of furnishing the variegated menus for dinners, but in terms of these essences.

Europe today is eating to live, and to live it matters little, for instance, whether fats are drawn from creamery butter, from margarin, from lard, or from vegetal oil or cheese. What does matter to Food Administrators is how much fat can be secured and can be delivered to the needy points with the least use of ships. To carry this instance further, as showing the far-reaching character of such calculations, I may point out to you that at one time Europe produced most of her own fats. To do this it was necessary to import a large tonnage of forage for their animals. It requires three times the tonnage to transport fodder that it does the fats made from feeding animals. Therefore, the various Allied administrations have stopped the overseas shipment of feed for food-animals, and it becomes our duty to find increased exports of fats and to direct our production to this end.

Any broad consideration of these problems requires a constant re-assessment not only of our own food-resources, but of the food-resources of the Allies and of other markets from which food may be brought to the Allied world. North America is the greatest factor in the Allied food-pool and in the final analysis it might become necessary for the Allies to live practically on North American supplies. It is therefore of importance to review our possibilities in this direction.

Our ability to supply the Allied world with food lies in four directions:

First, the United States usually produces a small surplus of food for export over and above our normal

*A speech delivered before the Pittsburgh Press Club, on April 18.

consumption. This surplus we can export without economic disturbance.

Second, we have for years exported to countries other than the Allies. By embargo of these shipments we can slightly increase the supplies available to the Allies.

Third, we can expand the area planted, and if our harvests are normal we can thereby enlarge the surplus for export through increased production.

Fourth, our normal consumption and waste of food are anywhere from 15 to 20% more than is necessary to maintain our own public health and strength, and we can in an emergency restrict the national consumption to our need, and thereby increase our exports.

We have thus, so far as the Allies are concerned, four marginal resources, namely, our small normal surplus, the embargo, an abnormal surplus to be created by stimulated production, and a further surplus to be created by a reduction in our consumption. Our resiliency of resources in these four directions, principally the latter, is such that we can, if we have the will to do so, maintain the strength of the Allies and of our own people. All talk of famine is mere hysteria. Our world-food situation is not to be interpreted as famine; at worst, it is to be interpreted in terms of soldiers to France, or, alternatively, it can be interpreted in terms of larger shipbuilding programs.

As to what our marginal possibilities of exports to the Allies may amount to, we can gain some idea if we review the situation since our last harvest—a period coincident with the period of the Food Administration. Because of the enormous demand upon us during the previous year, we entered the last harvest with our national stocks of cereals practically exhausted. We carried over less foodstuffs to the new harvest than at any time during many years. Our herd of hogs, which is our most ready and prolific source of fat, was apparently below normal as the result of previous years' heavy exports to the Allies—and we were faced with increased demands.

Owing to the fine activities of our Department of Agriculture and to the patriotic action of our farmers, a largely increased area in foodstuffs was planted for the 1917 crop, but because of weather conditions, the harvest was greatly damaged. Our wheat yield in proportion to the area planted was the lowest in many years, and in actual quantity we had no practical export-surplus over our normal consumption of this grain. A large portion of our enormous acreage of corn failed to reach maturity, and thus its food-value fell far below normal.

If we reduce our annual production to its actual nutritive value we find that our production of 1917 is about 7% below the average of the three previous years, and in the same terms we exported an average of about 10% of our production. Yet we expect that our exports to the Allies, measured in nutritive values, will this year again reach approximately the average of the three previous years. In other words, we have had to reduce our consumption by about 7% this year in order to do our duty by the Allies.

With the increased prosperity in wide sections of the community engaged in agricultural and industrial pursuits the standards of living in these regions have been raised and the food consumption of the American people materially increased. How acute this is may be indicated to you by the fact that our consumption of beef products apparently increased by 10% during 1917. We therefore had to stem the tide of increasing consumption.

The necessity of this reduction in consumption falls unequally on various commodities, depending upon their durability, their convenience in shipping, the food habits of the people we feed, etc. Nor are we able to anticipate in advance exactly what may be required from us in these disturbed times. As illustrating both points—we originally calculated that we must ship 100,000,000 bushels of wheat this year. Owing to the deficiencies in the importation to the Allies from more remote markets, we have had to raise this total to 160,000,000 bushels and to do this out of a home surplus of only 20,000,000 bushels over our normal consumption. Therefore, to feed the Allies we must take from our normal consumption of wheat, not 16% as we originally estimated, but 30%. Thus we have been compelled to increase the intensity of our conservation during the last half of the year. Wheat products are vital as a basis of war-bread to Europe because of their durability in transport and on account of the milling and baking equipment of the Eurepean peoples.

Another instance of the disturbances in original plans arose from the two and one-half months of storm weather which paralyzed our railways. Our hogs were blockaded on our farms, and the situation not only rendered difficult the supply of meats in this period, but the flood of animals released with improved transport overcharged our storage and shipping capacity. We therefore were compelled to relax our conservation efforts for a short period until the flood passed. You can thus readily see that there can be little fixity of policy in an administration that is dependent on the exigencies of war and shipping. We must alter our tactics from day to day to meet the changing world situation.

The reduction of consumption during this year has been vital. To secure it we had three alternatives of action:

First, rationing.

Second, by bidding up prices in the purchase of Allied supplies until the consumption falls.

Third, by obtaining a voluntary reduction of the individual consumption, simpler living, economy in waste, substitution of commodities that we have in greater abundance for those that we have to export.

Any system of positive rationing of the United States bristles with difficulties. Half the population are either producers or live in intimate contact with the producer and therefore cannot be restrained in their consumption by any rationing. The consumption of the very poor is not beyond the necessities of their health and strength. Our industrial population varies greatly in its habit of consumption of any given commodity in different parts of the country. Furthermore, this class of the com-

munity varies greatly in its habit in different sections of the United States as to the commodities it consumes. For instance, the worker in the South consumes perhaps not more than two pounds of wheat products per week per capita, whereas in some parts of the North he consumes eight pounds. Rationing of wheat on any broad national line would increase the consumption beyond necessity in the South and decrease it in the North below necessity. Furthermore, to adopt rationing as a positive system would cost the Government $10,000,000 or $15,000,000 annually in bureaucratic expense, as we should have to place tickets and coupons with every householder, and behind these tickets would have to be erected a vast administrative organization.

It has been believed by many that the best adjustment in consumption would be obtained by increasing price-levels in that commodity in which it is desired to reduce consumption by simply bidding up the price for Allied supplies. I feel strongly, however, that reduction of consumption to the extent that we require by an increasing price is simply and purely to place certain commodities out of the reach of those classes of the community who have not the purchasing power, and that this whole conception is simply conservation for the rich and against the poor. The adoption of this principle of rising prices would mean that the poorer sections of our community would have paid in suffering and the richer classes would have paid in price many score times the cost of any other system of reduction.

Furthermore, if we are to increase the price of our foodstuffs merely to decrease their consumption, we must enter a vicious circle of constant re-adjustment of wages, for our working people must live. Beyond this, again, we could no doubt reduce the consumption, for instance, of sugar by 20%, if we doubled the price, but to double the price of sugar alone means an annual drain on our population of $600,000,000, and this $600,000,000 would go into the hands of a vast number of middle-men and would give rise at once to profiteering, discontent, and would lay the foundations for social revolution.

In considering the whole problem, we determined upon a line not hitherto applied and the success of which we believe will be one of the remembered glories of the American people in this titanic struggle, that is, that we should place the reduction of consumption on a voluntary basis. We felt that we could secure voluntary reduction by savings which would be made not from the necessities of the poorer classes of the community, but in the saving out of plenty by the more fortunate classes.

Voluntary conservation has also a moral side, to my mind, of some importance. By it we are appealing directly to the self-sacrifice of the people of the United States in the carrying on of the War. I do not believe that there is another nation in the world in which the proportion of individuals of a willing sense of self-sacrifice is so high as in this people of ours, and in which a sufficient voluntary reduction could be obtained. Our program therefore has been a hazard upon the number of people of this kind in the United States. This basis of reduction gave some trepidation to the Allies, for fear of its failure, but I am happy to say that we shall have performed our national duty, the Allies will have been fed during this harvest-year, so far as the obligation falls upon us, almost wholly upon a voluntary footing. Far beyond this, it is justifying us in our belief in the high idealism of the American people.

We have had some criticism from individuals who believe that they should not be called upon to do more than their neighbors willingly do. In response to this, my feeling is that our Army does not fail to go over the top because there may be two or three slackers hiding in the trenches.

Aside from the prime necessity of protecting our independence and our institutions, there is but one possible benefit from the War, and that is the stimulation of self-sacrifice in the people, the lifting of its ideals and the diversion of its peace tendencies to the purely material things of life, to a strengthening of its higher purposes. I do not say that such compensations are full compensation for war, but they are at least an amelioration of the terrible currents that are threatening our existence. Therefore we felt that if there could be brought home to the sense of every American household the necessity of this personal and individual sacrifice, we would have spread the opportunity for service beyond those who sacrifice in giving their sons to immolation on the national altar.

To accomplish this requires education; it requires an intimate understanding for each man, woman, and child in the United States of the objectives of the Government and the duty that falls upon them. We have called upon the millions of women and men in the United States with an unfailing reply. We have created great numbers of committees who have worked with the utmost devotion. We have penetrated each of our 20,000,000 households periodically with literature and we have plastered the hoardings of the country with posters. We have secured the co-operation of the manufacturers and distributers of food. We could not have attained this had we not had the absolute devotion and team-work of every newspaper in the United States. Our every appeal has, through this gigantic influence, received an immediate and prompt distribution. Without this incessant, voluntary, liberal support, our plan would have been impossible.

There is another side of all this to those of us who have lived behind the German lines. No hour goes by but our hearts are haunted by the scenes of long lines of emaciated women and children who today and for three years have gathered in Belgium for their daily bread from America. That pittance—their all—represents scarcely the waste from American tables. This winter these lines have, for the first time during the War, gathered in the poorer sections of England, France, and Italy. Not only should this pull at our hearts; it is a menace to our very safety. In the presence of a common enemy we sit at a common table with all the defenders. Is the daily call of the Food Administration for less waste, for simpler living, to eat only for strength, not a call to conscience? Is it not a vital call of defence?

As to next year, we can formulate no plans until we know the harvest. Our farmers this year, despite great handicaps, are making the greatest of efforts. The weather is our real and final food-controller. If we have a bumper crop we can save many ships from long voyages. Even without a bumper crop, we could save more food next year. A crop failure, so far as to cause famine, is humanly impossible; the worst might compel more conservation.

The reduction of food-supplies below normal and all of the commercial difficulties connected with the aggregation of these reductions in disturbance to inland and overseas transportation have caused new currents in our economic life, and the Food Administration has, by force of necessity, had to pioneer untraveled paths in the economic jungle of war as an incident to its main purpose. For instance, there is a great deal of discussion throughout the country over price stabilization by the Government. That discussion is partly academic, partly misinformed, and most of it without any knowledge or admission of the total economic dislocations imposed by the War. So far the Government has developed no principle of price-fixing as a broad economic policy. Dislocations apply first to one great commodity and then to another, and therefore our aspect of the problem is to deal with them as they arise, commodity by commodity. We are dealing with conditions and not with theories.

Disturbance through shortage in supply, failure of inland or overseas transport, or because of the other matters with which we must contend, all lead to hardship on either producer or consumer. Our view is to review the alternative courses of action and to choose that course which leads to the lesser hardship. We are not exploiting economic reform or economic revolution. Up to the present time, and as far as I can see at the moment, what may be called the incidental policy of the Government is the only one that it will be necessary to apply, and it may be summarized in the following statement:

Every export from the United States today is under control. It is controlled that it may serve the positive military ends of the Government. All of our exports are directed to supporting the Allies, or, alternatively, where we deal with neutrals, to get the *quid pro quo* for the sacrifice of our commodities. Thus our food exports are directed toward but a few hands on the other side of the water.

With the shortage in shipping, it has been necessary for these governments to put available shipping into use for the common purpose, in order to secure the utmost expedition in loading and discharging at ports of call, and to arrange that it be loaded with the most advantageous commodities from a national point of view.

It was found by experience to be absolutely impossible to trust to the normal commercial agencies to select the prime commodities necessary for national existence among the Allies and to trust to the incidental operation of trade to maintain the maximum handling of shipping. Furthermore, these commodities are distributed by their governments under rationing systems, and thus must, in any event, come into government hands. Therefore the European governments have been compelled to undertake, as the consequence of shortage on supplies, the single-handed purchase of their supplies both for civil and military purposes. There has thus grown up an enormous consolidation of buying of 120,000,000 European people, a phenomenon never before witnessed in the economic history of the world.

Furthermore, we have aggregated in this country something like 2,000,000 men under arms, and we shall probably expand our forces to three or five million before we are finished. The buying for these men is necessarily concentrated in one agency, instead of 5,000,000 separate agencies as before, and we have thus a second great engine growing up in our midst as a necessity of war conditions. In order that these two buying agencies should not get in each other's way, it has been necessary to place them under joint direction. In the final outcome, therefore, we find ourselves in the presence of a gigantic monopoly of buying just as potent for good or evil as any monopoly in selling, and in many instances either making or influencing prices. Therefore, not through any theory, but through an actual physical fact, the price made by this gigantic buyer dominates the market.

This is price-fixing in a light never contemplated in economic history or theory, and it is time that economic thinkers denude themselves of their procrustean formulas of supply and demand and took cognizance of it. In commodities where this situation arises, the Government must necessarily regulate the price, and all theories to the contrary go by the board. So far among food commodities only wheat is positively involved, and pork prices are influenced by the volume of buying.

It is entirely possible for the Government to make these purchases to the best advantage of the Allies and of the Army and Navy and to disregard totally the civilian population, either the consumer or the producer. Where these purchases aggregate such a volume as to make inroads on the normal consumption of the civilian, it would mean that the residue would go to the highest bidder. This would be conservation again for the rich and not for the poor, with a vengeance. Had we allowed this to go on in wheat, flour would today be $40 per barrel, instead of at a universal price of practically $12.

The producer is also subject to damage by these great buying agencies. Production of food does not take place evenly over the year; it is seasonal. It is entirely possible for such a monopoly to manipulate prices in the season of surplus marketing to figures below the producer's cost. Again, transportation both inland and overseas is subject to every vicissitude of war. Temporary stoppages in transport can produce speculative disaster unless some stability is given to markets. Therefore both sides, consumer and producer, must be safeguarded by wise direction of this buying power, and this is bound to result in price regulation in certain commodities in just protection to both.

But right at this point arises to me a fundamental principle in national war economics. I do not believe

that any person in these United States has a right to make one cent more profit out of any employment than he would have made under pre-war conditions. I do not care whether this refers to the farmer, to the laborer, to the manufacturer, to the middle-men, or to the retailer; to me, every cent taken beyond this standard is money abstracted from the blood and sacrifice of the American people.

I do not believe that extortionate profits are necessary to secure the maximum effort on the part of the American people in this War. If we are going to adopt that theory, we have admitted everything that has been charged against us of being the most materialistic, the most avaricious, and the most venal of people in this world. If we are going to admit that the Government, in order to secure the supreme efforts of its citizens in production must bribe them with money for this extra exertion, we have admitted a weakness of American character, of American civilization, and of American ideals that puts us on a plane below German kultur.

Do not mistake, I am not saying that prices and wages should return to the pre-war normal, because the incidence of war before we joined in it had lifted our costs of operation, and there must be compensation in every direction. Nevertheless, I hold that any man who has made more than his necessary living out of the cost this nation is giving in blood of the boys we are sending to France should not stand out as a benefactor to his community.

I have had this statement met before now with the expression that it is dreamy idealism, but I have found no individual who was prepared in his own instance to defend any such line of action. It is true that this doctrine has been made law only to the larger food trades. I am confident that profiteering has from a national point of view disappeared in the regulated food trades, and in consequence my belief is that it should be applied generally to all business in this community, and it is also my belief that before we are finished with this War, that will have been done.

To me, this goes much further than the mere case of the individual and the blame that may be attached to him. As I have seen this War develop from an active participation in its backwash and misery since its first day, I have seen growing out of the masses of people in every country aspirations for a great economic change. That change, broadly, will be, in the view of extremists, that those who work with their hands will obtain a larger portion of this world's goods and those who work with their brains will obtain less, while those who do not work will probably obtain nothing.

If we are to bring about this economic change in an orderly and American way, and not by convulsions during the period of recuperation from the War, we must lay the foundations for it now. None of us wants a repetition in the United States of the history of the last twelve months of Russia. The proper social development of this country along these lines fills the background of all men's minds and its proper guidance rests upon the liberal and thinking men of the country.

The enforcement of this law against profiteering in the food trades is a considerable part of our anxieties. In order to determine how far we have succeeded, that is, how far the margin between the producer and consumer has been diminished, we maintain positive data in our organization. To illustrate this, we have calculated a price-index based upon the food-values of the principal commodities. For instance, a rise of a half-dollar per dozen in eggs would be a good headline, but it is not as important to the country as a rise of a cent per loaf in bread. Upon this basis we find that since the Food Administration was founded the price of food commodities has increased 18% to the producer and at the same time it has decreased 12% to the consumer. The margin is thus smaller by 30%, in fact, it is now so narrow that price-charges to the producer directly reflect to the consumer, and the Food Administration has to take all of the curses of both sides.

This has been accomplished largely by voluntary co-operation of the food trades. Ninety-five per cent of our traders desire to serve the common interest and the measure of their co-operation is one of the most illuminating proof of the high sense of service in our people. While isolated instances will occur, I am convinced that at no time in the last three years has there been as little speculation and extortion in the nation's food as there is today.

Another economic theme which the Food Administration has had to pioneer is that of saving. Speaking broadly, we have some thirty-six millions of able-bodied manhood. We have already had to divert two millions of these men to actual arms. Beyond this we have had to divert a vast number of men to provide munitions not only for ourselves but for the Allies. We have had to divert vast numbers of men to the provision of the raw materials for these shops. We have had to set aside larger amounts of our foodstuffs for the Allies, and consequently there was a diversion of farm production to this purpose. Altogether, a rough calculation indicates that already we have diverted from eight to ten million men from their normal occupations toward war and the products it requires. That is from one-quarter to one-third of our normal productive units. It is possible that we can increase the exertion of the remainder of our productive population by eliminating non-essential labor, by more intensive labor and longer hours, by the application of woman's labor, by putting the boys into labor earlier than otherwise, and can make up some of the gap in our productive units. We cannot, however, compass the whole, and the deficiency can only be overcome by the reduction in the consumption in commodities.

This does not apply to food alone, it applies to every commodity of which we consume more than is necessary for our health and comfort. We must strip to the bone in order that we may afford the economic luxury of the diversion of this portion of our productive power to the destruction of war. If we do not, our exertion in this War will stop short of the task imposed upon us, and we cannot look to victory with any assurance.

When we survey the economic field in detail, we neces-

sarily find difference in the degree of the essential character of commodities and labor. There are some commodities and some labor that we do not require at all, and all that we can turn to our shipyards, our munition works, and the Allied food supply is a contribution to war.

Too much economic thinking is done in terms of money. If we could, like Germany, reach that point of economic balance where the increased productivity of our home population and the decreased consumption of our home population affords the complete supply of men and commodities needed in war, we could fight for the next fifty years without economic loss. Money becomes purely the counters through which distribution of those commodities and labor is obtained.

If we subscribe for one Liberty bond from our normal surplus income, we will have furnished the Treasury with some of its necessary counters, but if we subscribe for another Liberty bond from the savings that we make on the consumption of commodities and labor we will have contributed these commodities or this labor to the War, and our second bond will have done two duties. Without it, neither the Treasury will have enough counters, nor our fighting men enough supplies. The subscription of Liberty bonds is no sacrifice for the American people. The Government is agreeing to re-pay you. It is the saving that we make in the consumption of commodities and in the employment of labor that is the sacrifice for the winning of this War.

Another prime economic theme by which I am impressed in this War is this: The American ideal in executive work is efficiency, but efficiency does not alone mean the best appliances and the greatest number made for the least cost. In war it involves a new factor that transcends all others—speed. Many of our present difficulties arise from our inability to get away from our trodden interpretation of the word 'efficiency,' and many of them from the fear of our executive officers of criticism if they fail in popular interpretation of this term.

In this light the measures taken, the results attained, cannot be judged by the microscopic inspection of the threads in the tapestry—its broad lines, its inspiration, must be attained quickly, not by years of careful development. It will be of no avail to us if we lose a war, though it cost less per unit than any war in history.

We are a discouragingly critical people. Those of us in Washington are damned if we do, and damned if we don't.

There is but one real test for Washington. Our game is to win the War, and the test is, do we keep our eyes on the ball? For, friends, this people will be cursed for the next ten generations if we don't. Nor does this test apply to Washington alone. We in the Government can often criticize also, and our right of criticism lies against that minority of people who hope for self-interest out of winning the War. This Government is nothing more than the expression of the people, and if we are to win the War, it will be only because every man, woman, and child charges himself daily and hourly with the test, does this or that contribute to win the War?

Galena in Wireless Apparatus

Some months ago the superintendent of the Scranton mine in Tooele county, Utah, received a communication from the Bureau of Standards, at Washington, asking him to forward several hundred pounds of galena. Accompanying this request was a statement that the galena from the Scranton mine was particularly valuable as forming a part of wireless apparatus. It developed later that the Bureau of Standards had secured, from some of the technical men at Washington, a series of samples of galena ore from various mines in the United States. Small fragments or crystals of galena are used as contact-points on portable wireless-telegraph outfits. These crystals are set in a cadmium alloy known as Wood's metal, which has a melting-point below the boiling-point of water. The Bureau of Standards, in testing the various samples of galena for the purpose mentioned above, discovered that the galena from the Scranton mine possessed some properties that made it desirable above that of any other mineral tested. It had earlier been discovered that in a large piece of galena there were certain small particles that would effectively serve the purpose, but the mass of mineral was either worthless or so weak in its properties that it was not desirable for the use intended; also that out of several thousand fragments perhaps one or two from the same mass could be utilized. The galena from the Scranton mine was uniformly good. In order to discover what peculiar property the galena from this mine possessed, very careful chemical analyses were made in an effort to determine the presence of some element not contained in other ores. Tests were also made on the radio-active properties of the mineral; the galena was studied under reflected light, and its crystallographic, physical, and electrical characteristics were carefully investigated. The most refined examination by the best talent in the Government service has been unable to discover the reason for the galena from the Scranton mine possessing the especially desirable characteristic not shown in other ores. A member of the Bureau of Standards was recently sent from Washington to Salt Lake City for the purpose of getting a supply of suitable galena. The mine from which the mineral was taken has orebodies of combined zinc and lead, with a little silver. The ore occurs in limestone and is thoroughly oxidized, so that the occurrence of galena is rather uncommon. It took two weeks of careful search and considerable work to collect 300 lb. of galena. It might be noted that in a mine whose ore appeared to be identical in every respect, situated some distance to the west, the galena proved valueless for the wireless telegraph. The whole problem of securing suitable contact-points seems to be one of trial in actual operation rather than by determination through any known analysis.

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Formulas for Mine-Valuation

By W. W. WHITTON

The tables in common use for the valuation of mines are based on what is commonly known as the Hoskold formula. In 1877 was published the first edition of the 'Engineer's Valuing Assistant' by H. D. Hoskold; a second edition appeared in 1905. In this book is to be found an algebraic deduction of the formula, together with extensive tables of mathematical equivalents. Smaller tables are to be found in Hoover's 'Principles of Mining' and in Finlay's 'Cost of Mining.'

In this paper I have undertaken to give a deduction of the Hoskold formula, and to show that this formula does not correctly represent the algebraic relationship between the several quantities recognized as entering into the valuation of a mining investment, and that, at ordinary rates of interest and usual years of life, the factors based on the Hoskold formula are in error by as much as 20%. It is probable that this error has passed unnoticed because of the algebraic method commonly used for its deduction. In this it is assumed that the annual dividends of a mining investment constitute an annuity, and the algebraic notation of actuaries is employed. This notation is confusing to those not familiar with actuarial calculations, and I shall therefore develop the formulas by simple algebra. The deduction so performed is longer, but it will be more easily grasped by the engineer.

The Hoskold formula attempts to express the algebraic relationship between present value or capital, rate of interest, and the term or years of life of a mining investment. By so doing the attempt is made to place mine-valuation upon the same basis as the ordinary investment of capital, as for instance the purchase of a mortgage or a bond. On investing capital in a bond the years it has to run is not a matter of great importance, because the investor understands that a sinking-fund is being created, which, at the expiration of the term, will restore the capital. A mining investment, however, is of the class known as a wasting asset, or of that class in which the payment of returns on the investment necessarily results in the destruction of the property in which the capital is invested. Hence the term or years of life of the mine is a matter of vital importance. Other classes of investments give at least some guarantee of the return of capital, and it would be desirable that mining as far as possible should be placed upon the same basis; we should, therefore, in theory at any rate, provide for the return of the capital to an investor, as well as allow for the payment of interest according to the risk assumed.

Mining companies do not generally establish a sinking-fund that will return the capital to an investor. Possibly they should do so, as has often been claimed; but it appears that this should be left to the investor, except in special cases. During the early stages of the development of a mine the stock may be worth intrinsically but a small fraction of its par value; likewise, when the payments of large dividends are assured, the same stock may be worth many times the par value. Investors may have purchased stock throughout the entire range of prices, and the mine officials have no way of determining the price at which stock was acquired. Therefore the attempt to provide for the return of capital by mining companies seems to be improper, but it is none the less a matter of importance to the individual investor. Hoskold appears to have been one of the first engineers to recognize this principle in mine-valuation, and he has shown that each dividend received by the investor is to be regarded as composed only in part of interest on the investment, and that the remainder in theory must be set aside to provide a sinking-fund that will return the capital at the exhaustion of the mine. In other words, this balance is to be regarded as an installment to be paid annually into the sinking-fund, and this portion must be of such amount that, when re-invested in a safe security, as, for example, when deposited in a bank at 4% compound interest, it will amount to the sum originally invested at the time of exhaustion of the mine.

This theory of the formation of the sinking-fund may be made clearer if the investor, in the case given by Hoskold, will regard the capital he has put in the mine as a 'loan' to the mine. The mine as the 'borrower' is to pay a proper rate of interest on the loan, and, of course, must return the amount borrowed to the lender. In view of the fact that, on the exhaustion of the mine the 'borrower' will be powerless to return the capital to the lender, each dividend must consist of interest and an additional amount sufficent, if reinvested at compound interest at 4%, to equal the amount borrowed when the mine is exhausted and dividends cease.

Upon this Hoskold has based his formula; it is sound in theory, but as an hypothesis it is incomplete. There are several ways in which the amounts paid as interest and those paid into the sinking-fund may be apportioned, and also in which the sinking-fund may be accumulated. Hoskold's hypothesis is that interest is to be paid at the stipulated rate on the entire sum originally invested during the total life of the mine; this requires a constant amount of interest each year to be taken out of the dividend, hence there is a constant installment paid annually into the sinking-fund. I regard this division of the dividend between interest and sinking-fund as incorrect, and shall attempt to so demonstrate, after giving a deduction of the Hoskold formula.

The algebraic quantities entering into the deduction of the Hoskold formula are as follows:

j = the rate at which the sinking-fund installments are to be placed at interest. This is taken at both 3½ and 4% in the United States; in England, rates of 3 and 3½% are used. For 4% $j = 0.04$.

i = the rate to be realized on the investment. This may vary in practice from 4 to 30, or even 40%. It is itself composed of several factors. It must be greater than j, the rate that can be realized safely on an investment with practically no risk of losing the capital. Other elements entering into this factor are that it must be great enough to compensate the investor for the risk assumed and for the labor of supervision of the investment, and probably a desirability factor, an insurance factor, and others. This matter has been discussed at some length in Burnham's 'Modern Mine Valuation.'

d = the amount of annual dividend (in dollars).

n = the term of the investment or years of life of the mine.

V = the present value of the investment.

According to Hoskold's hypothesis, each annual dividend d is the sum of two quantities, namely, interest and a payment into the sinking-fund. The amount of the annual interest on the capital V is Vi; hence the amount of the sinking-fund installment is $d - Vi$. Both V and d being constants, the annual payments of interest and into the sinking-fund are constants throughout the interval of n years.

The first installment paid into the sinking-fund will remain at compound interest at rate j for $n-1$ years; hence, at the end of the term of n years, it will amount, according to the well-known formula for the amount of a sum at compound interest, at the exhaustion of the mine, to $(d - Vi)\ (1 + j)^{n-1}$.

Similarly the second installment paid into the sinking-fund will remain at interest at rate j for $n-2$ years, and at the exhaustion of the mine will amount to $(d - Vi)\ (1 + j)^{n-2}$. The third installment similarly will amount to $(d - Vi)\ (1 + j)^{n-3}$. The hypothesis is that, when the mine is exhausted in n years, the sinking-fund will amount to V, that is, the amount of the original investment. Hence

$$V = (d - Vi)\ (1 + j)^{n-1} + (d - Vi)\ (1 + j)^{n-2} + (d - Vi)\ (1 + j)^{n-3} \ldots (d - Vi)\ (1 + j)^2 + (d - Vi)\ (1 + j) + (d - Vi).$$

As $(d - Vi)$ is a common factor, this equals the expression

$$V = (d - Vi)\ [(1 + j)^{n-1} + (1 + j)^{n-2} + (1 + j)^{n-3} \ldots + (1 + j)^2 + (1 + j) + 1].$$

The expression within the brackets is a geometric series with a ratio $(1 + j)$, and the sum of this series is $\frac{(1+j)^n - 1}{(1+j) - 1}$; substituting this value for the sum of the brackets we have

$$V = (d - Vi)\frac{(1+j)^n - 1}{(1+j) - 1} = (d - Vi)\frac{(1+j)^n - 1}{j}$$

The above equation contains all of the factors entering into the deduction of the formula; therefore, without further substitution, it may be employed for the computation of the Hoskold factors, but for this purpose it should be simplified by grouping the terms of like order. The equation thus becomes

$$V = d\frac{(1+j)^n - 1}{(1+j)^n i - i + j}$$

Assuming an annual dividend of one dollar, or unity, Hoskold's factors are obtained by substituting the required values for i and j. As a typical case, and as an aid to the discussion of the formula, take a mine with an expected life of 10 years, paying an annual dividend of $1000, the rate to be allowed on the investment to be 10%, with the sinking-fund placed at interest at 4%. From Hoskold's tables the value of this investment is $5455.80691. The following redemption table will illustrate the application of the Hoskold formula:

Year	V	Dividend d	Vi	$(d - Vi)$		Amount of sinking-fund
1	$5455.81	$1000	$545.58	$454.42	$646.78	$454.42
2	5455.81	1000	545.58	454.42	621.91	927.02
3	5455.81	1000	545.58	454.42	597.98	1418.52
4	5455.81	1000	545.58	454.42	574.98	1929.68
5	5455.81	1000	545.58	454.42	552.87	2461.28
6	5455.81	1000	545.58	454.42	531.61	3014.15
7	5455.81	1000	545.58	454.42	511.16	3589.14
8	5455.81	1000	545.58	454.42	491.50	4187.12
9	5455.81	1000	545.58	454.42	472.60	4809.03
10	5455.81	1000	545.58	454.42	454.42	5455.81
					$5455.81	

The foregoing table, constructed on the hypothesis upon which the Hoskold formula is based, shows that the annual dividend of $1000 is divided, throughout the 10-year life of the mine, into two constant parts. The dividend of 10% on the capital of $5455.81 requires $545.58; and the balance, which is $1000 less $545.58, or $454.42, is paid into the sinking-fund, where it accumulates at 4% compound interest. The sixth column gives the amount of each installment, accumulated at 4% interest, compounded annually, at the end of the tenth year. The sum of this column is the amount of the original investment. The last column gives the total amount in the sinking-fund at the end of each year, and the error in the Hoskold formula is plainly exhibited by this column. Consider, for example, the amount in the sinking-fund at the close of the ninth year, which the table gives as $4809.03. Of the original capital put into the mine there remains in fact only the difference between the total in the sinking-fund and the amount originally put in, or $5455.81 less $4809.03, which is $646.78; and this amount only is exposed to the risk that calls for the payment of 10% interest on the investment. The remainder of the original capital has passed through the hands of the investor and has been placed in some safe security bearing 4% interest. It is, therefore, unquestionably a fallacy to require a mine to pay a high rate of interest on the entire amount originally invested during its entire life; and more especially is

this true when, as in this example, the value of the remaining one year's dividends is but $909.09. Imagine a borrower that has paid back all of a loan of $5455.81 except $646.78, which he had borrowed at 10% interest, and that he still is required to pay interest at 10% on the amount originally borrowed.

This error in the Hoskold formula and the factors based thereon seems to have passed unnoticed. The only direct reference to it that I have seen is that Inwood makes the comment, regarding the factors to be used in valuing loans, that the terms of such loans are onerous to the borrower. It even appears to be commonly assumed in mining literature that Hoskold's formula is based on the assumption that the mine does pay interest only on that portion of the capital unreturned to the investor, whereas the direct opposite is the case. Nor is this error small in amount. As I shall later show, the true value of the investment given in the above table is $6591.37, which is practically 20% greater than the Hoskold factor.

I shall now give the deduction of a formula that rectifies this error in the Hoskold formula, and which I believe to be the correct formula to be used for mine valuation. This is based upon the same assumptions as the Hoskold formula, with the added provision that interest shall be paid at the risk-rate i only upon the unreturned capital, and that the unreturned capital shall be the amount of the original investment less the amount in the sinking-fund. The amount in the sinking-fund at any time is the amount paid into this fund out of dividends plus the added accumulations of interest at the rate j. Thus, taking V as the present value of the investment, it is the amount of the unreturned capital over the first year. At the end of the first year the annual dividend, of amount d, is paid. This dividend is made up of two parts; Vi is the interest requirement on the capital at the rate i; thus $d-Vi$ is the balance placed in the sinking-fund. For the period of the second year the unreturned capital then is, according to the hypothesis taken, $V-(d-Vi)$. At the close of the second year the dividend d is again paid. Allowing interest at the rate i on the unreturned capital, the interest requirement of this second dividend is $Vi-i\,(d-Vi)$; and the payment into the sinking-fund from the second dividend is the difference between the constant dividend d and this interest requirement, or $d-Vi+i\,(d-Vi)$. The total amount in the sinking-fund at the close of the second year is the sum of the amount paid into the sinking-fund at the close of the first year plus the interest on this first payment for one year at the rate j, plus the amount paid into the sinking-fund at the close of the second year; the expression for this is $(d-Vi)\ (1+j)\ +\ (d-Vi)\ (1+i)$.

This may be simplified to $(d-Vi)\ [(1+j+i)+1]$.

Thus, the unreturned capital over the third year is $V-(d-Vi)\ [(1+i+j)+1]$.

At the close of the third year the dividend d is again received. The computation for the third year is somewhat lengthy, but it is a matter of simple algebra to show that the sinking-fund, after the receipt of the third dividend, amounts to

$$(d-Vi)\ [1+i+j)^2+(1+i+j)+1].$$

Similarly, for the fourth year it can be shown that the sinking-fund will amount to the expression

$$(d-Vi)\ [(1+i+j)^3+(1+i+j)^2 + (1+i+j)+1].$$

Obviously, then, for a life of n years, the sinking-fund will have accumulated to the amount of the following expression, which by my hypothesis equals V, or

$$V=(d-Vi)\ [(1+i+j)^{n-1}+(1+i+j)^{n-2}\ \ldots + (1+i+j)^3+(1+i+j)^2+(1+i+j)+1].$$

The expression within the brackets is again a geometrical series with a ratio $(1+i+j)$; the sum of this series is equal to $\frac{(1+i+j)^n-1}{(1+i+j)-1}$, and, substituting this expression for the sum of the series in the above equation, the result is

$$V=(d-Vi)\frac{(1+i+j)^n-1}{(1+i+j)-1}$$

Solving this equation for V, and grouping the terms according to their order, the result is

$$V=d\,\frac{(1+i+j)^n-1}{(1+i+j)^n i+j}$$

The factor for any particular case can be computed readily from this formula by assuming d to be unity, and putting $(i+j)$ equal to J. The formula then becomes

$$V=\frac{(1+J)^n-1}{(1+J)^n i+j}$$

and the value for $(1+J)^n$ may be taken directly from Table I of Hoskold's tables, pages 31 to 48. The value of the numerator and denominator in the expression may be figured arithmetically, and the computation completed by means of logarithms.

As an example of the application of the new formula, and to exhibit the difference between it and Hoskold's, I give a redemption table constructed from the same case as that taken for the discussion of the Hoskold formula. This is the case of an investment paying an annual dividend of $1000, the life of the mine to be 10 years, the investor to realize 10% on his capital, and the sinking-fund to be accumulated at 4%; the amount of capital at any period remaining invested in the mine is to be considered as the amount originally put in less the amount accumulated in the sinking-fund. The present value of this investment computed by means of the new formula, is $6591.37, and the following redemption table has been constructed:

Year	C	d	Ci	$(d-Ci)$	Amount in sinking-fund
1	$6591.37	$1000	$659.14	$340.86	$340.86
2	6250.51	1000	625.05	374.95	729.44
3	5861.93	1000	586.19	413.81	1172.42
4	5418.94	1000	541.89	458.11	1677.43
5	4913.93	1000	491.39	508.61	2253.13
6	4338.22	1000	433.82	566.18	2909.44
7	3681.91	1000	368.19	631.81	3657.62
8	2933.72	1000	293.37	706.63	4510.56
9	2080.78	1000	208.08	791.92	5482.90
10	1108.44	1000	110.84	889.16	6591.37

The second column is headed by *C*, which is the amount of capital remaining invested in the mine. The original capital is $6591.37. At the close of the first year a dividend of $1000 is received by the investor. As 10% of the capital is to be paid as interest, this absorbs $659.14 of the dividend. The remainder of the $1000 dividend, which is $340.86, is placed in the sinking-fund. During the second year the capital remaining invested is equal to the original $6591.37 less the amount of the capital now returned, which is $340.86, leaving $6250.51. At the close of the second year interest requirements have decreased to $625.05; and the remainder of the dividend of $1000, which is $374.95 is paid into the sinking-fund. The amount in the sinking-fund at the beginning of the third year is now the sum of the first instalment of $340.86, plus interest on this sum for one year at the rate of 4%, which is $13.63, plus the amount paid into the sinking-fund at the close of the second year, which was $374.95; the sum of these three amounts is $729.44. The capital remaining invested is now the original $6591.37, less $729.44, or $5861.93. The quantities given in the table are found in the same manner for the succeeding years.

Compare the situation at the close of the ninth year in the table constructed from this new formula, with the table constructed upon the Hoskold formula. Under the new formula, at the close of the ninth year the investor has in hand a sinking-fund totalling $5482.90; hence the capital remaining in the mine is only $1108.44. Hence, the interest requirement from the ninth dividend is but $110.84, instead of $545.58 as called for by the Hoskold formula. It is also shown that, by allowing the investor 10% interest only upon that part of his capital that has not been returned to him, rather than allowing him 10% interest on the amount of his original capital throughout the entire life of the mine, the value of the investment has been increased from $5455.81 to $6591.37; the true value of this income is therefore shown to be $1135.57 greater than the value given by the Hoskold factor. In other words, the Hoskold factor in this particular case is too low by 20.8% of the amount given in the tables.

There is no simple ratio between Hoskold's factors and the factors based on the new formula. The computation of the new factors can be made readily by the method previously outlined. It has seemed worth while to discuss this error in the Hoskold formula at some length; the factors based on this formula have been employed in computing the value of properties worth many millions of dollars, where an error much smaller than the percentage shown in the example taken would of itself be a large sum. I think it is clear that the Hoskold factors are seriously in error, and that the formula which I have deduced is a correct one to employ in the valuation of expected dividends from mining properties.

AN APOPHYSIS is a branch from a vein or dike to which it is attached; an epiphysis is the same but not attached.

Metal Business of Hongkong

Hongkong occupies a rather peculiar position in the metal trade of the Far East. In normal times it is the distributing centre for practically all metals sold in China, the East Indies, Indo-China, the Philippines, Formosa, the South Seas, Siberia, and other parts of the Orient. Because of certain freight and financial advantages it has of late been a distributing centre for tinplate, steel plates, and other supplies for Japan, imported from Europe and the United States. It is normally the distributing point of Australian lead for that part of the world. On the other hand, China's production of tin, antimony, wolfram, and Siam's wolfram, and in short all other metals produced in the Far East find much of their market in the world through Hongkong. The result is that in times like the present Hongkong's metal market not only follows the ups and downs of other markets with regard to each metal, but by reason of its peculiar position, the influence of silver exchange, and the colony's special relation to the finances of the Far East, its metal market has special features of its own. The great feature of the distributing trade for the past year has been the increasing dependence upon the United States for all supplies and, on the other hand, the increasing demand in the United States for metals produced in the Far East and exported through Hongkong—particularly tin. The chief import has been various forms of iron and steel. The movement in this direction of all the standard forms, but particularly plates, bars, hoop-steel, etc., was strong at the beginning of the year, but in the closing months the effects of export restrictions in the United States were felt.—'Daily Metal Reporter.'

HARDNESS OF ALLOYS may be obtained by additions of relatively small amounts of different metals, as, for example, 1% of tin in copper hardens it 10% on the Brinell scale, and 15% tin increases the hardness 300%. Annealing such bronzes has but little effect on their hardness. Small amounts of zinc harden copper slightly, but with 35% zinc the alloy suddenly becomes very hard. Adding tin or aluminum to brass makes it brittle, unless annealed. Lead and bismuth soften copper, but 15% lead added to tin doubles its hardness, while larger quantities of lead again soften it. Copper and antimony harden zinc, and the same effect may be produced with 0.25% magnesium as with 4% copper. Magnesium is the best hardener for aluminum.

GYPSUM is added as a flux to galena concentrate in the Carmichael-Bradford blast-roasting process of reducing lead ore, as practised in New South Wales. In Germany gypsum is used in reverberatory treatment of leady copper matte. Also in New Caledonia gypsum is employed as the source of sulphur in smelting nickel to form a matte, while the lime in the gypsum supplies the base for fluxing the silicious portion of the gangue.



NEW YORK

A. I. M. E. and Enemy Aliens.—A New Hudson Tunnel.—Gold-Leaf Industry.

It has been announced that the American Institute of Mining Engineers will decide during the present month to erase from its roll all honorary, normal, associate, and junior members who are subjects of enemy countries. The Chemists Club is also taking steps toward the same end, and has issued a questionnaire inviting information as to the nationality and sympathies of all its members. The use of the German language has been prohibited in the Club. Sympathizers of alien countries, whether American or alien, are asked to resign forthwith.

The New York State Bridge and Tunnel Commission has reported favorably on the project of connecting Jersey City with Manhattan Island (New York City), by tunnel, and recommends that the work be commenced without delay. The subway will be arranged for foot and vehicular traffic. Estimating an average toll of 30c. for each vehicle and a total of 1,300,000 per year, the project would result in a profit of $1,500,000 after 20 years of operation. The entrance on the New York side of the Hudson will probably be at the foot of Canal street; and the exit on the New Jersey side at the foot of Twelfth street. Preliminary estimates show that the cost of the tunnel will be $12,500,000, and that the work will take three years. The subway, when completed, will obviate the danger of coal famines during severe weather when navigation across the Hudson river is hindered by ice. The completion of the work will favor the scheme of arranging for an accumulation of coal on the New Jersey side rather than in New York City, where there is little available space.

The action of the Federal Trade Commission in alleging an illegal combination of the principal gold-leaf manufacturers in the United States, draws attention to a method of increasing the local market value of the beaten product. The evidence indicates that the combine reduced the available supply for the domestic market, and forced up local prices by a scheme which included the exportation and marketing of the gold at a reduced price, the losses from this source being met by the increased profits being made locally. Gold-leaf contains only a small proportion of silver and copper, as the inclusion of other metals decreases its ductility. Nothing is gained by adulteration, as the sheets are sold by surface area and not by weight. Small bars of the alloy are annealed and rolled in steel mills to a ribbon 1/800 inch thick, which is again annealed and cut into squares, 1 by 1 inch. These are placed between vellum and beaten until their total surface measurement is 3½ by 3½ in. The leaf is then placed between gold-beaters skin (an ox membrane) and beaten with a lighter hammer until a leaf about 1/2500 inch thick is obtained. This is trimmed into 3½-in. squares, and placed between the leaves of a small book, and marketed in this form.

The mining and quarry industry of New York State is detailed in the State Museum Bulletin 196 by D. H. Newland. The important minerals extracted are feldspar, gypsum, graphite, iron ore, salt, limestone, and talc. Molybdenite occurs in the heart of Manhattan Island (New York City), but is covered with buildings.

VICTORIA, BRITISH COLUMBIA

Bounty on Pig-Iron.—New Mining Regulations.—Smelting Charges.

A bounty on pig-iron manufactured in British Columbia is the policy of the Provincial government, according to the Hon. William Sloan, Minister of Mines. He has introduced a bill to the Legislature Assembly providing that on pig-iron manufactured from ore mined in the Province a bounty shall be granted not to exceed $3 per ton, and that a similar grant, not to exceed $1.50 per ton, shall be allowed on pig-iron manufactured in the Province from ore mined outside its boundaries. This is considered in western Canada as the most important step taken in years to promote the iron industry in the North-West. It is known that the Province



has immense bodies of unexploited magnetite ore, high in quality. All the authoritative reports available on these deposits have been studied, satisfying the Administration that the iron-ore resources are sufficient to warrant some progressive measure to induce development. The Government has the power to procure diamond-drills and to enter on iron properties held for speculative purposes, and by drilling to estimate the probable tonnage. This will be done, the expense being charged to the property, and, if the owners then take no action, the law will be applied to force them—at least that is the present outlook. An expert in electric smelting is coming from eastern Canada to investigate and submit a report on the best methods of treating these iron ores. All of these investigations should lead to the foundation of pig-iron production in this territory. It is possible that the Dominion government will assist British Columbia in stimulating interest in this matter. A deputation of Victoria and Vancouver citizens is waiting on the Federal authorities at Ottawa urging that action in this direction be taken. It is felt that the Dominion and the Province

should co-operate where the National, and even Imperial, interests are so largely at stake, and those engaged in making these representations feel certain that their efforts will not be in vain. The policy of a bounty on pig-iron is not a new one to Canada. It was adopted by the Dominion government in 1894, when $2 per ton was offered on pig-iron and steel. In 1897 this was raised to $3. In 1903 a bounty of $3 was placed on wire rods, $3 on structural steel, and the same on rolled plates. These bounties were extended to 1907. Pig-iron manufactured from Canadian ore from 1907 to 1910 was allowed a bounty of $2.10 in 1907, to 90 cents in 1910. On pig-iron made from foreign ore during the period from 1907 to 1910 there was a bounty graded from $1.10 in 1907 to 40 cents in 1910. On puddled-iron bars it was placed at $1.65 in 1907 and graded down year by year until in 1910 it was 60 cents per ton. Bounties also were given on rolled round iron bars. As to the successful working out of this policy it is only necessary to point to the present position of the two companies which derived the greatest advantage, namely, the Nova Scotia Iron & Coal Co. and the Dominion Iron & Steel Company.

Since the above was written the Iron Bounties Act, which binds the Province to give a bounty of $3 per ton on all pig-iron manufactured from British Columbian ore within its borders, and $1.50 per ton on all iron manufactured in the Province from foreign ore, is easily the most important mining legislation passed at the recent session of the Provincial Legislature. It went through the House without difficulty, the consensus of opinion being that it was good policy and an opportune move on the part of the Government to encourage the development of the admittedly large deposits of iron in the province. An eastern Canadian iron expert has been engaged by the Government to report on the practicability of reducing the ore by certain furnaces—electric and otherwise. The Minister of Mines stated that none of the known deposits has been worked other than surficially, and few have received any further development than shallow open-cuts, tunnels, or shafts. On Vancouver and Texada islands there is probably 5,000,000 tons. An engineer considers that on the southern coast of the Province there is 630,000 tons of magnetite ore actually exposed, 6,050,000 tons probable, and 10,500,000 tons possible. The magnetite deposits are always replacements of limestone. The iron content is from 50 to 65%, on 600-ton lot averaging 65.7%. Plenty of coke is available for reduction purposes.

['Iron Ore Occurrences in Canada' is the title of a recent bulletin issued by the Department of Mines at Ottawa. This work is in two volumes. A pocket contains 33 large maps. The introduction is by A. H. A. Robinson, while the whole was compiled by E. Lindeman and L. L. Bolton. As a reference for future development of the iron industry the publication is worth securing.—Editor.]

Several changes in the Metalliferous Mines Inspection Act of British Columbia have been made by the Legislature. One provides that all drills used must be attached to a water-spray. This is aimed particularly at a type of drill, which was used here extensively at one time, mostly without such an attachment. Another makes provision for substantial platforms at intervals of not more than 20 ft. in all shafts, whether vertical or a few feet off vertical. Formerly this rule applied only to vertical shafts. A third makes it obligatory for the inspector, after an examination, to post outside the mine a notice describing the condition in which he found the workings. This has been the rule in connection with coal mines, but has not been applied to metal mines in this Province until the present.

The smelting charges recently announced by the Consolidated Mining & Smelting Co., which has the greatest custom works in western Canada, has roused the silver-lead mine operators of British Columbia, who claim that it will mean the closing-down of the majority of their mines. In response to their petition, the Dominion government has approved of a Commission of Investigation into the schedule and its justification, and the company has expressed its willingness to allow an inspection of its plant and books. Orville R. Whitaker, of Denver, Colorado, has been asked to act in an advisory capacity as an independent expert. The Provincial government will be represented at the inquiry.

MAYER, ARIZONA

New Work in This District.

The Arizona Copper & Mining Corporation is cross-cutting east and west on the 500-ft. level of the new shaft. A shipping grade of chalcopyrite and silver ore was cut 30 ft. west of the shaft, this week. Another vein is expected a short distance east of the shaft. This strike is considered important, as it is the first deep mining that has been done in the district within the past 10 years. The mine adjoins the old Hackberry on the north, a producer 20 years ago, and now owned by the Phelps-Dodge Corporation. The Arizona mine is one mile south of the Boggs, also a Phelps-Dodge property. It is in a strong schist belt, being a parallel vein system to the Blue Bell-DeSoto mines one mile west. The directors are considering sinking an additional 500 ft. or develop the present 500-ft. level. No attempt will be made to build a mill until the mine is thoroughly developed. The president of the company is A. L. Davis, and consulting engineer, F. J. Hobson, both of Prescott.

The Mayer Ore Purchasing Co. has leased and overhauled the old Gray Eagle mill one mile east of Mayer, and will operate it as a custom plant. A 100-ton flotation unit has been erected, also two Butchart tables for coarse concentration. As soon as certain electric equipment can be obtained oxidized copper ores will be leached. A custom assay-office has been opened, also sampling works. Ores will be bought for outside reduction works. The new enterprice is in charge of H. A. Wagner, who devised the electrolytic process for which the mill was originally built.

A contract to sink the main shaft at the Copper Mountain Mines Co.'s property on the north end of Copper mountain, has been let to B. H. Bradley and Oscar Holtz of Jerome. It is to be sunk from the 150 to the 600-ft. level. This old shaft was used 25 years ago by the late Isaac Stoddard when he operated the old smelter on the Agua Fria river. S. C. Chaney, mine superintendent of the Arizona Binghampton company, 1½ miles north, is manager for the Copper Mountain company, while the president, Celora Stoddard, is serving in France.

Machinery has been ordered for a 50-ton flotation unit by the Pocahontas Mining Co., two miles south-east of Mayer. The ore is silver-lead, assaying $20 milling grade, and considerable 100 oz. silver and 20% lead ore for smelting. The mine is well developed.

LEADVILLE, COLORADO

Pyrite and Manganese.

The Leadville district contains some of the greatest deposits of iron pyrite in the United States. This was made clear recently by the arrival here of George C. Venard of Chicago, and F. Morse Smith and E. C. Rafferty of New York, members of the purchasing committee representing the acid manufacturers of the country. They have been appointed to investigate the domestic supply of pyrite, and contract for the purchase of such ores as are found to be up to standard. These men spent a day in the district examining the deposits in many of the big mines, including the Greenback, Yak, Moyer, Mahala, and Wolftone, where immense bodies have been opened by past development. Following their inspection, they stated that the deposits exposed here are the largest in the United States that are now open to easy extraction. The ores are of standard

grade, and steps will be taken by the committee co-operating with the Government for fixing a price that will make their development profitable to the operators. It is expected that a heavy tonnage of this ore will be produced during the last half of the year.

During April, lessees on the Bohn shaft on Carbonate hill, shipped 500 tons of 36% manganese. This is the best output that has yet been made by manganese producers in this district. The Bohn deposit is regarded as the largest and highest grade manganese in the State.

Leadville went over the top in the third Liberty Loan, subscribing $300,000 with a quota of $233,000. More than 2000 subscribers applied for bonds.

CLOVERDALE, CALIFORNIA

Operations Along the Quicksilver Belt.

Owing to the present prices and demand for quicksilver, production of the Sonoma County area promises this year to greatly exceed all former yields. This zone, roughly outlined by proved mines, is known to extend from a point 20 miles east of Cloverdale to the Sulphur Bank mine in Lake county, approximating 40 miles. Mercury is now being produced by the Cloverdale, Culver-Baer, Western Mineral, Rattlesnake, Socrates, Big Injun, Big Chief, Helen, Mirabel, Oat Hill, Aetna, and Sulphur Bank mines, and others. The steady price for the metal has given confidence to these companies. At all of these mines development is under way. The Socrates mine is probably the most important. It was re-opened May 1, after being closed for 60 days on account of a re-organization. It is predicted that during the summer it will produce more than ever. William Navas, foreman of the Socrates mine, stated that the company proposes at once to drive an adit 2100 ft. on No. 6 level, to cut the orebody at a depth of 400 ft. below present workings. At the plant of the Western Minerals Co., 2½ miles west of Geyser Springs, Andrew Rocca Jr., superintendent, and 30 men are employed, handling ore that averages 10%. Production at this mine is said to be about 125 flasks per month. Rocca is also superintendent of the Helen mine, farther east. Labor conditions are causing some uneasiness in the district. Charles Humbert, president of the Culver-Baer mine, 19 miles east of Cloverdale, stated that this property is now capable of producing, by running the two furnaces to full capacity, from 20 to 80 flasks per month, grade of ore determining output. This statement was qualified, however, by an explanation that wages of $3.50 to $4 per day were no longer attractive. On account of labor conditions, he said it was becoming increasingly difficult to keep production up to normal.

SUDBURY, ONTARIO

International Nickel Co.: Merger and Taxation.

The International Nickel Co. of Canada, a subsidiary of the International Nickel Co. of New Jersey, is arranging a merger with the Canadian Copper Co., another subsidiary of the same concern, operating the company's mines at Sudbury, with a capital of $50,000,000. The Canadian company has a capital of $5,000,000. It was organized in 1916 to carry out the arrangement made by the parent company with the Dominion government to refine in Canada all the nickel required for the British Empire. In pursuance of this agreement it is now constructing a large refinery at Port Colborne, Ontario. The large increase in capital indicates that operations at the Canadian refinery will be on a much more extensive scale than originally contemplated, which is easily accounted for by present conditions. In addition to the heavy taxation imposed by the Provincial government, amounting to $750,000 per annum, the New Jersey company is subject to war taxes on its business in the United States, and by transferring its operations to the Canadian side of the border, it can escape the double tax. As the Port Colborne refinery is being built on the unit system, additional capacity can be made as required. The view in official circles is that operations of the company will be gradually withdrawn from the United States and centred in Ontario. The Canadian Copper Co. has appealed in vain to the Dominion government against the Ontario tax, and asked for its disallowance. It was contended that under the method adopted for assessing the profits liable to taxation, profits made in the refining process carried on in the United States were included; also that the law discriminated unfairly between the International and the Mond Nickel companies, the latter being allowed to deduct from its taxes the amount paid in Great Britain where its ore was refined, whereas no allowance was made to the International on account of American taxation. These objections were overruled, and the appeal dismissed.

Boston Creek.—The machinery for the new mill of the Patricia Syndicate has arrived on the property, and is being installed. It has a capacity of between 50 and 60 tons per day. Charles O'Connell, formerly manager of the Tough-Oakes, is manager and part owner.

LEAD, SOUTH DAKOTA

Gold, Lithia, and Mica Mining.

Lead.—The annual report of the State Inspector of Mines, Otto Ellerman, covering the year 1917, has been published. Mining was quieter than for a number of years. Regular producers continued on a normal basis. Bullion extracted was only $62,348 short of 1916. Copper, gypsum, lead, lithia, and tungsten ores showed increases, and are expected to do so in 1918. There were 2757 men employed at all mines, a decrease of 312. There ware 7 fatal accidents. Operations of the operating companies are briefly described. Production was $7,501,284 gold and silver, $247,096 tungsten, $47,500 gypsum, $25,620 lithia, $25,268 coal, $9259 mica, $8275 tin, $6695 lead, $1887 copper, and $1670 manganese. Tin decreased $6000 and tungsten $140,000.

The Bismarck gold mine at Flatiron has been leased to Edward Manion, formerly superintendent of the Wasp No. 2. The property is equipped with a 200-ton cyanide mill, which will be placed in commission as soon as development warrants it. The ground adjoins the Wasp No. 2 on the north, and has been operated intermittently for the past few years.

Deadwood.—After continuous work for over 35 years the Golden Reward Consolidated Gold Mining & Milling Co. has suspended work. Experiments on the blue ores will be continued, but the main work has been stopped. This is one of the larger producers in the district, and the reason for closing is due to advanced costs, the ore not being rich enough to be profitably treated. Development of the Cutting property continues. Two drifts are being extended to cut the ore. The lower of these is in over 200 ft. It is expected that the ore developed at a higher level will be cut within a short distance. An installation of power machinery is under consideration.

Keystone.—The Ingersoll mine has been leased to A. T. Roos and associates, who will place it in shape for shipping lithia ore.

Rhodes and Woods are shipping mica from the George Palmer property near Spokane. Several carloads have already been shipped to the Eastern market.

The Dakota Continental Copper Co. is loading ore for the smelter. It is all taken from surface workings at the Calumet mine. Work at the Golden Summit, near Hill City, which this company has been developing for over a year, has been suspended.

The Rheinbold and Standard Essence companies continue regular shipments of lithia ores. In addition to this the Rheinbold is marketing some mica.



ALASKA

Juneau.—Alaska Gastineau in April treated 125,435 tons of ore assaying $1.148 per ton. Extraction was 81.45%. This is a reduction of nearly 25,000 tons from the March output.

Kennecott.—The Kennecott Copper Corporation is to acquire control of the Mother Lode Mines Co. through a new company with 250,000 shares of no par value, the Kennecott to hold the majority. Approximately $1,000,000 will be paid the Mother Lode company, which has been unable to finance development.

ARIZONA

Kingman.—Material for the McCracken Silver Lead company's 100-ton mill is arriving and construction started.

Ore assaying $50 per ton has been opened on 400-ft. level of the Banner mine. This company is erecting a new compressor and other machinery.

The Mohave Molybdenum Co. has been organized to work claims in the Wallapai mountains.

Jerome.—At request of both sides, the hearing for the claim for $250,000, freight overcharge to the United Verde Extension by the railroads, has been postponed indefinitely.

Oatman.—The Tom Reed Gold Mines Co. reports as follows for the past two years:

	1917	1916
Ore treated, tons	81,656	46,170
Value per ton	$7.60	$11.03
Extraction, per cent	97	.....
Cost of mining	$2.20	$2.65
Cost of milling	$2.04	$2.09
Profit	$90,000	$170,000
Reserves, tons	80,000	.....

The new orebody in the Bald Eagle claim will be ready for milling by July. W. B. Phelps is superintendent.

Nogales.—The Arizona European Mining Co., which commenced operations last fall, is making good progress. In the old shaft 460 ft. of sinking and other work has been done. Six cars of ore yielded 14% copper and 4 oz. silver per ton. A new shaft has also been sunk 115 ft. and some driving done.

It is reported that high-grade copper-sulphide ore has been opened in the west drift of the 40-ft. level of the old Hickory mine. Molybdenite has also been found on two levels, claimed to carry as high as 8% MoS_2.

Patagonia.—The Hilltop mine is making excellent progress in the lower adit, where 50 men are employed.

The Nippers mine is employing a small force on development under H. W. Loomis.

The Blue Eagle mine is to start work immediately. F. A. Shaw has interested New York capital in the mine.

Word has been received that work will start on the Hardshell mine in a few days, M. Saunders, who has a lease and bond on it, having secured financial backing.

Ray.—The dry-concentrating plant of the U. S. Vanadium Co. has been completed. Preliminary trials, it is reported, indicate that the mill will be a success.

Rodeo.—The King Copper mine is 12 miles north-west of Rodeo on the Southern Pacific railroad. Ore carries lead, silver, and copper. The power-house encloses a 200-hp. Webber distillate engine, 80-kw. Westinghouse electric generator, 800-ft. Ingersoll-Rand compressor, and other plant. There was recently installed a Westinghouse generator and switchboard, also a 10,000-gal. fuel-oil tank. The concentrating mill is nearly complete, and when all units are finished they will have a capacity of 150 tons per day. David Snyder of Denver is president.

CALIFORNIA

At the public meeting of gold-dredge men, held on May 7 at the offices of the Industrial Accident Commission, as mentioned in this journal of May 11, to discuss the amended tentative safety rules for dredges, attention was mainly directed to first-aid training and electric safeguards, in so far as they were more easily complied with by the larger companies operating a number of boats than by companies operating one or two boats in remote parts of the State. The rules as they have been amended will come up for discussion at a meeting of the dredge operators to be held at Lodi on May 16, 1918. This meeting is expected to develop more accurately the feeling of operators at this time of high costs of supplies and low efficiency of labor, also whether the rules will create undue expense to those boats operating on a small margin of profit. The final meeting of the committee for considering the rules before presenting them to the Commission for adoption will be held on June 20 at 10 a.m., at its offices at San Francisco.

Bay Point.—The Pacific Electric Metals Co. on May 13 started its new 40-ton ferro-manganese plant here.

Kennett.—The Mammoth Copper Co. has sold the 4½-mile Quartz Hill railroad for junk. The road was built in 1903 to haul silicious rock from the Quartz Hill mine to the Southern Pacific line at Cuargo for shipment to the smelter as flux. Three hundred tons was shipped in seven years. Now the company gets flux elsewhere to better advantage.

Livermore.—J. E. Stock and J. J. Cummings Jr., of the Western Magnesite Co., have been ordered by the Master in Chancery at San Francisco to pay the company $26,883.07 for magnesite mined and sold, on the grounds that the mining claims were obtained by fraud. The defendants contended that they had spent $60,000 at the property and were entitled to expenses; this was denied them. The mine is 40 miles south of Livermore, which is the nearest rail point.

Lewiston.—The Trinity Star Dredging Co. has suspended construction of its boat, owing to war conditions and the shortage of labor.

Redding.—Three carloads of machinery have been received at Redding by the American Gold Dredging Co. This is from a dismantled boat in the Oroville district.

Trinity Center.—The Estabrook Gold Dredging Co. has been unable to raise its dredge, which sank about a month ago, and has abandoned it. A new one is being built.

After closing down since last October the Bonanza King mine is to be re-opened. The compressor has been repaired, power-line overhauled, and considerable re-timbering done.

COLORADO

Cripple Creek.—Residue dumps at the Golden Cycle and Portland are reported to contain from 8 to 10% potash, so an experimental plant costing $50,000 is to be erected to devise a process of extraction.

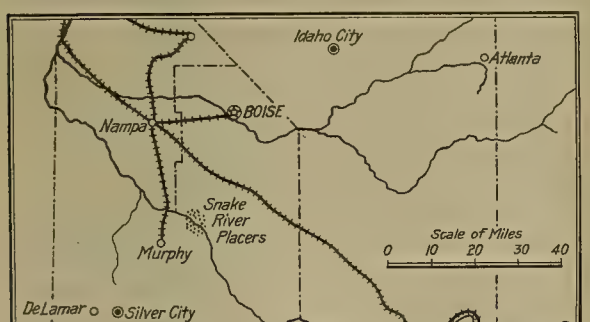
A U. S. Bureau of Mines safety-car is soon to visit this district.

The Cripple Creek Deep Leasing Co.'s lease on the Jerry Johnson mine has expired. The bottom, or 950-ft. level, has been leased to P. H. Denham.

Leadville.—The Greenback Mining Co.'s management has passed from Patrick Mulrooney to A. K. McDaniel, with H. C. Watson in charge of the mine. Pumps and air-connections in the 1350-ft. shaft are to be overhauled, also surface machinery. Ore opened is considerable, but low grade; and a third of the ground has not been explored. Most of the ore consists of pyrite, high in sulphur with a little silver, estimates placing the quantity at 300,000 tons.

IDAHO

Stampmill.—This new silver district is on the western slope of the Owyhee range, 5 to 7 miles south of Silver City in Owyhee county. Little deep work has been done so far.



PART OF IDAHO, SHOWING SITUATION OF STAMPMILL DISTRICT.

The district was prospected in the early sixties. A number of mines are being worked and several mills are contemplated, the Owyhee Silver Mining Co. being one of them.

Wallace.—The Friend Mining Co. in the Beaver district is opening lead-silver-zinc ore, is repairing the wagon-road, and contemplates ordering a crusher, ball-mill, table, and flotation plant. From 60 to 100 tons of concentrate is expected monthly. William Schierding is manager.

We are informed that the Grasselli Chemical Co., under a contract with the Success Mining Co., received the entire output of zinc ore and zinc concentrate, and that no dispute has ever arisen over the proper settlements for shipments. The new management of the Success company requested a modification of this contract in the direction of a higher price, which could not be granted on account of prevailing conditions in the zinc industry.

MISSOURI

Joplin.—Production of the region last week was 8088 tons of blende, 338 tons calamine, and 1519 tons lead, averaging $42, $30, and $80 per ton respectively. Total value was $494,923, making $8,555,357 for 18 weeks. Oklahoma contributed $297,680 and Kansas $84,861. About 1400 tons of high-grade blende was sold at $75 per ton, the new basis for this product, as arranged with the Government.

MONTANA

Butte.—At the Black Rock shaft of the Butte & Superior a skip fell from the surface to 1200-ft. level, damaging one compartment considerably. This resulted in a shut-down for several days.

Helena.—The A. S. & R. Co. has raised wages 25c. per day to its East Helena smelter employees. The minimum is now $3.40 per shift.

Polaris.—The Silver Fissure Mining Co. is starting work on a 50-ton mill, involving chloridizing roasting and hyposulphite leaching of silver ore.

NEVADA

Bullfrog.—This centre is reported to be more active than for some years. Liberty Loan subscriptions totaled $17,000, a third more than the quota.

Cuprite.—After being closed for 10 years the sulphur deposits here, 15 miles from Goldfield, are to be re-opened. James Forman of Tonopah and A. S. Putney of Manhattan have been examining the district.

Manhattan.—In the apex suit of White Caps v. Morning Glory, Judge M. Averill on May 8 upheld every contention of the plaintiff.

The Commercial Mining & Milling Co. has leased the Big Pine mill. This is a combination ball and pebble mill. A large quantity of dump ore, assaying from $1.25 to $1.90 per ton will be treated.

Rochester.—Net profit of Rochester Mines Co. for first quarter of 1918 was $62,988, against $46,934 in the last period of 1917.

Sodaville.—This tungsten district is having a revival, and Beck & Noonan, Edward Wagner, Berndy Tungsten Mines, Mark Young, and the Tungsten & Gold Telluride companies are busy developing ore.

Tonopah.—The first survey of a railway to the Gold Mountain district is finished, but two others are to be made to try better grades. In the six miles will be some deep cuts, and a rise of 800 ft., equal to a 3% grade.

OKLAHOMA

Picher.—The zinc-lead region last week yielded 5118 tons of blende and 1112 tons of lead, valued at $297,680.

UTAH

Alta.—The Little Cottonwood Transportation Co.'s new freight schedule means a reduction of 50% on haulage charges from this district to the main line.

Dugway.—The Lucky Star Copper Co., which is shipping a little ore, may construct a small mill.

Park City.—Ore and concentrate production of this district in April totaled 8392 tons, compared with 11,500 tons in March. Ontario led with 2800 tons, followed by Judge with 2173 tons, Silver King Coalition with 1387 tons; Silver King Con. with 1072, and Daly West with 550 tons.

Tintic.—Ore and concentrate output of this district in April totaled 30,000 tons from 35 producers.

CANADA

British Columbia

Silverton.—The Galena Farm Mining Co. is shipping lead and zinc concentrates. The latter carries 41% metal. On 100-ft. level the ore-shoot is 300 ft. long. There are 70 men engaged.

Trail.—The former schedule for payments on lead ore received at the smelter were restored on May 1.

Ore received at the smelter here during the third week of April totaled 7729 tons. Le Roi contributed 2679 tons, Sullivan 1858 tons, and Centre Star 1317 tons. One hundred and four tons came from the Mandy mine, Pas district, Manitoba.

Ontario

Kirkland Lake.—The Ontario-Kirkland Gold Mines has $50,000 and is to start work on its Hurd claims near the Wright-Hargreaves.

Lightning River District.—Assessment work on claims in this area, recently stopped on account of possible damage to the Abitibi Power & Paper Co.'s property, is to be resumed.

Porcupine.—McIntyre-Porcupine mine is in splendid condition. Profits are equal to 25% on capital. Main drift on 1000-ft. level from McIntyre claim through Extension and into Jupiter will soon be finished. It will be about half-mile long. Electric locomotives will haul ore-cars to main shaft. Mill has a capacity of 600 tons daily.

Yukon

Dawson.—Ten miles above the Yukon Gold Co.'s power-house, on the Little Twelvemile, D. B. Cole and others have opened a promising lead-silver deposit. In spite of difficulties and 38° below zero, the owners mined 40 tons of ore, which was sorted to 6 tons worth $150 per ton. About 18 claims have been staked in the vicinity.

The ice of the Yukon broke on May 11, doing considerable damage at Dawson.

Tagish.—Venus mine of J. L. Harper, formerly of Republic, Washington, has a new mill dressing lead-silver-gold ore. T. B. Landers is in charge.

MEXICO

Chihuahua and Sonora

Report of the Mines Company of America, operating mines in both of the above States, has been issued. Owing to unsettled conditions in northern Mexico no ore was treated last year. There was an operating loss of $92,138 for 1917. The surplus of $975,154 at the end of 1916 was reduced to $642,690, by depreciation, loss, taxes, etc. Reserves in the properties are as under, gold being calculated at $20 and silver at 90c. per ounce:

Company and situation	Tons	Total value
Dolores Mines Co., Chihuahua	149,223	$2,900,651
Chihuahua-Esperanza Gold Mining Co., Chihuahua	2,550	52,530
Consuelo Mining, Milling & Power Co., Chihuahua	.....	.....
El Rayo Mines Co., Chihuahua	78,538	1,068,289
Creston-Colorada Co., Sonora	190,350	1,220,080
La Dura Mill & Mining Co., Sonora	16,015	1,265,125
Total	459,676	$6.506,675

Normally these mines employ 1500 people. The directors are considering resumption of operations.

Guanajuato

Guanajuato.—The Guanajuato Reduction & Mines Co. reports that full capacity was reached late in April 1918. The American staff left the mine in April 1916, but returned in July 1917, when the political outlook and cyanide supply looked better. Freight, supplies, taxes, etc., were much higher, but silver was also higher and it was expensive to maintain the property ready for operation. In December, 80 of the 160 stamps started crushing ore, gradually dropping more until now all are in operation. To secure supplies an arrangement was made with one of the companies operating privately-controlled trains under contract with the National lines. Expenditure in Mexico during 11 non-operating months of 1917 was $70,437. Tests by flotation were not favorable, but are being continued. The general manager, H. P. Smith, reports that a re-calculation of reserves in the mines gives the following:

Ore	Tons	Silver, gm. per ton	Gold, gm. per ton
Blocked out	186,180	253	2.87
Probable	146,400	256	2.78
Dumps	481,966	165	1.40
Total and averages	814,546	202*	1.98†

*7 oz. per ton. †0.06 oz. per ton.

The cash balance at beginning of 1917 was $243,825, and at end of year $58,021. The company has Liberty Bonds worth $5000.

Hidalgo

Pachuca.—The report of the U. S. Smelting, Refining & Mining Co. for 1917 has the following to say regarding operations by its subsidiary, the Compania de Real del Monte y Pachuca:

In Mexico, during the first part of the year, operations were still hampered by difficulties mentioned in the last annual report. Only one mill could operate, and that at only part capacity. Operations continued to be conducted at considerable loss until June. As anticipated, the second mill commenced to operate during the second quarter and from July to the end of the year both mills were operating, and for the last six months averaged 54,600 tons monthly, which was over their rated capacity of 50,000 tons. Substantial profits were made from June to the end of the year, and still continue. While wages have increased at the Mexican property, labor efficiency there improved to the extent that practically offsets such increase, but the increased cost of cyanide, dynamite, timber, and other materials purchased in the United States and transported to Mexico under extraordinary difficulties and heavy expense, more than offset the increased price of silver realized during the year. None of the ore from the new vein was mined and treated during that period, except what came from development work and a small amount of stope preparation. At one mill an additional capacity of 9000 tons monthly is being completed and put into operation during the first quarter of 1918. At the other mill, the installation of an additional capacity of 9000 tons monthly is being delayed by various difficulties, but it is now expected that this will go into operation during the first quarter of 1918. The new mill of 15,000 tons capacity contemplated for treatment of ore from the new vein is being delayed for various reasons, some of which are: first, that while the ore thus far developed in this new vein is several times richer (and has eight or more times the profit-value per ton) than the average ore treated during the year, and now being treated; second, it is somewhat more complex, and much time has been required to carry on experiments necessary to ensure the best method of treatment; and, third, almost prohibitive difficulties and high costs of obtaining and transporting materials for this proposed new construction. On account of this delay, plans are under consideration for immediate commencement of mining some of the ore from this new vein, and treating it in the present mills. This will displace and postpone the treatment of some of the lower grades of ore now being treated, but should add materially to earnings for Mexico for the balance of the year 1918. Another feature which should help to increase earnings is that developments in the new vein have continued to be so satisfactory that taken together with results in some of the company's other mines, there is enough ore blocked out and in sight to warrant discontinuing developments in some inactive mines and to reduce prospecting and development expense in all our Mexican mines.

Sonora

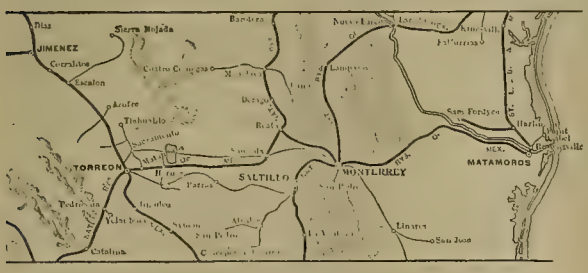
Nacozari.—El Canario Copper Co., controlled by the Canario Copper Co., is operating El Canario, 15 miles east, and the Lillie and Lillie Segunda mines, 3 miles west of

Nacozari. El Canario adjoins La Caridad of the Moctezuma Copper Co., and ore carries copper in the form of enargite. A 300-ton flotation plant is contemplated. The Lillie has been shipping intermittently, but in about 60 days will be producing a carload of 20% ore daily. This also carries a fair quantity of silver. The ore is said to be desirable for smelting, as it contains 10% lime. The Lillie Segunda has considerable prospects. James P. Harvey is president of the company, residing here, and S. H. Pyle is superintendent.

The San Nicolas Leasing Company, with properties situated about 15 miles west of Cumpas, has just completed construction of a 50-ton flotation mill, expected to be in operation early this month. The plant is owned by six Douglas men who have secured a three-year lease on some valuable silver properties, the ores of which will be concentrated in the new mill. It is expected that about two tons of concentrate will be milled daily, shipments to be made to smelter at El Paso. W. R. Maycumber is in charge of 30 to 35 men.

Tamaulipas

Nuevo Laredo.—A Consular Report states that there are several promising mining regions contiguous to this centre, although there is no important activity at present. There are also indications of oil. In the vicinity of Guerrero, a



PART OF TEXAS AND PART OF MEXICO.

village 85 miles down the river from Nuevo Laredo, there is a coal deposit. This property is still undeveloped, owing to absence of railroad facilities. The zinc and lead deposits are in the Villadama mountains, and along the railroad between the towns of Lampazos, Guadalupe, and Villadama. These properties are now being worked and the product exported to the United States.

Exports through this port to the United States for the last two years are as under:

Metal	1917	1916
Copper, pounds	349,751	279,399
Gold, value	.....	$96,001
Lead, tons	6,712	5,052
Quicksilver, pounds	3,300	.....
Silver, ounces	820,234	979,058
Tin, pounds	3,700	5,400
Zinc, tons	.....	561
Zinc ore, tons	44,245	72,474

Nuevo Laredo derives its importance from the fact that it is the gateway to Mexico and the seat of the principal Mexican 'port of entry' on the national boundary. It is a transshipping centre of great importance to the United States and Mexico.

PERU

La Fundicion.—Cerro de Pasco produced 5,952,000 lb. of copper during April.

Morococha.—The Morococha Mining Co. will erect a smaller mill similar in general arrangement to the addition to be made to the mill at Cerro de Pasco. The products will be sent to the smelters of the Cerro de Pasco company at La Fundición.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Frank L. Sizer is in eastern Oregon.

John W. Finch was at Yokohama recently.

J. A. Martin has left Alaska and is now at Cleveland, Ohio.

The partnership of **Hills & Willis** has been discontinued.

C. H. Jones has returned from Siberia and is now at St. Louis.

E. P. Mathewson is now residing at Santa Barbara, California.

W. E. Sanders, formerly at Butte, is now living at Pasadena, California.

J. Parke Channing has been in San Francisco, on his way to Miami, Arizona.

D'Arcy Weatherbe sailed on the 'Tenyo Maru' for Yokohama, on his way to Manchuria.

John D. Hoffmann sailed from San Francisco on May 14, for Yokohama, on his way to China.

Murray Coleman has resigned as superintendent for the Atolia Mining Co., and is proceeding to Japan.

L. C. Uren, assistant professor of mining at the University of California, is doing work in the oil department of the Fuel Administration.

David H. Collier left for Namtu, Burma, India, on May 14, to take a position in the engineering department of the Burma Corporation.

Alfred Tellam has been appointed metallurgical engineer for the Hardinge Conical Mill Co., with headquarters at Salt Lake City and Denver.

H. W. Morse, of the Western Precipitation Co., has been engaged as chief chemical engineer to the American Trona Corporation in place of C. P. Grimwood.

E. W. Bullard, safety engineer with E. D. Bullard, is now second Lieutenant in the 347th Regiment of Field Artillery, Camp Lewis, Washington. He was married to Miss Esther Bull on April 4.

Obituary

Lucius S. Pierce, inventor of the gold amalgamator bearing his name, died at Denver, Colorado, three weeks ago.

Percy Le Roy Fearn was injured in an automobile accident at El Paso on April 15 and died the next day. He graduated from the Columbia School of Mines in 1887. His son, Hewitt, also a graduate from Columbia, and now in the Regular Army, came from camp near Portland, Oregon, to be present at the funeral. At one time he was in partnership with Messrs. Olcott and Corning in New York. Recently he was operating the Lady Franklin mine, at Kingston, New Mexico. The news of his death will be a shock to many members of the profession, by whom he was regarded as an honored friend and a skilful engineer.

Edward Hale Perry, Lieutenant in the 6th Engineers, has been killed while at the front in Picardy. He was born in 1887; he graduated from Harvard College in 1909, and from the Harvard Mining (the Lawrence Scientific) School in 1912. Until 1915 he worked, in the laboratory and in the field, at the problem of secondary enrichment, and from 1915 to 1917 he was associated with Augustus Locke in the geologic examination of mines. He made a special study of rock alteration in connection with ore deposits, and had begun to make good use of it in a practical way. He was a man of imagination and energy, promising to be a mining geologist of the first rank. The early, but glorious, end to so promising a career will sadden many besides his personal friends.

THE METAL MARKET



METAL PRICES

San Francisco, May 14

Aluminum-dust, large and small lots, cents per lb	65—70
Antimony (wholesale), cents per pound	15
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7¼— 8¼
Platinum, pure and with 10% iridium, per ounce	$108—$116
Quicksilver, per flask of 75 lb	$110
Spelter, cents per pound	9¼
Zinc-dust, cents per pound	17½

ORE PRICES

May 14

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38% and over, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton (nominal price)	$7.00—$8.00
Manganese, 40 to 50% Mn, Hazen, Nevada, cents per unit	92—110
Manganese, 48%, New York, per unit	$1.20
Molybdenite, per lb., 85% MoS_2	$1.80
Pyrite, domestic, New York, cents per unit of sulphur	28
Tungsten, 60% WO_3, California, per unit	$24

Carnotite (radium-bearing) ores: the mining and concentration of these ores is fully described in Bull. 103 of the U. S. Bureau of Mines, just to hand.

EASTERN METAL MARKET

(By wire from New York)

May 13.—Copper is strong though unchanged. Lead is quiet and steady. Spelter is firm and higher. Platinum is nominal up to $150.

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to make prompt settlements with smelters and others, producers allow a discount from the Government price of $1, hence the lower price. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the current rate of exchange.

Date	New York, cents	London, pence
May 8	99.50	49.12
" 9	99.50	42.12
" 10	99.50	49.12
" 11	99.50	49.12
" 12 Sunday		
" 13	99.50	48.87
" 14	99.50	48.87

Average week ending	
Apr. 2	92.12
" 9	91.74
" 16	93.73
" 23	97.35
" 30	99.66
May 7	99.52
" 14	99.50

Monthly averages

	1916	1917	1918
Jan.	56.76	75.14	88.72
Feb.	56.74	77.54	85.79
Mch.	57.89	74.13	88.11
Apr.	64.37	72.51	95.35
May	74.27	74.61	....
June	65.04	76.44	....
July	63.06	78.92	....
Aug.	66.07	85.40	....
Sept.	68.51	100.73	....
Oct.	67.86	87.38	....
Nov.	71.60	85.97	....
Dec.	75.70	85.97	....

Although silver in New York averaged 81.41c. per oz. in 1917, the Nipissing Mining Co. received 83.19c. net at Cobalt, Ontario. There was 3,798,802 oz. sold on company account.

Silver exports from San Francisco to the Orient during April amounted to $7,206,637. Early in May a very large shipment was made, but figures are not available. It is reported that $13,000,000 was to be sent to the Orient on about May 14.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. In February 1918 the Government fixed prices for grade A spelter at 12c. per lb. for itself and the open market. This grade constitutes only a small proportion of the total output. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c. per pound.

Date	
May 8	7.12
" 9	7.12
" 10	7.25
" 11	7.25
" 12 Sunday	
" 13	7.25
" 14	7.25

Average week ending	
Apr. 2	7.33
" 9	7.23
" 16	7.00
" 23	7.00
" 30	6.88
May 7	7.00
" 14	7.21

Monthly averages

	1916	1917	1918
Jan.	18.21	10.75	7.87
Feb.	19.99	10.45	7.97
Mch.	18.40	10.78	7.67
Apr.	18.62	10.20	7.04
May	16.01	9.41	....
June	12.85	9.63	....
July	9.90	8.98	....
Aug.	9.03	8.58	....
Sept.	9.18	8.33	....
Oct.	9.92	8.32	....
Nov.	11.81	7.76	....
Dec.	11.26	7.84	....

High-grade zinc-ore producers in the Missouri-Kansas-Oklahoma region have arranged with the Government that present requirements of this ore for sheet-zinc makers are to be allocated by a committee appointed by the War Industries Board. The price of $75 per ton is suggested. P. B. Butler, O. F. Brinton, and John Hoffman, all of Joplin, were selected to serve as the allocating committee to decide on the quantity to be supplied by each producer.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67c. for small lots, effective until June 1, 1918. Quotations in cents per pound are as under:

Date	
May 8	23.50
" 9	23.50
" 10	23.50
" 11	23.50
" 12 Sunday	
" 13	23.50
" 14	23.50

Average week ending	
Apr. 2	23.50
" 9	23.50
" 16	23.50
" 23	23.50
" 30	23.50
May 7	23.50
" 14	23.50

Monthly averages

	1916	1917	1918
Jan.	24.30	29.53	23.50
Feb.	26.62	34.57	23.50
Mch.	26.65	36.00	23.50
Apr.	28.02	33.16	23.50
May	29.02	31.69	....
June	27.47	32.57	....
July	25.66	29.67	....
Aug.	27.03	27.42	....
Sept.	28.28	25.11	....
Oct.	28.50	23.50	....
Nov.	31.95	23.50	....
Dec.	32.89	23.50	....

Copper production of some of the mines in April was as under:

Mine	Pounds	Mine	Pounds
Anaconda	26,500,000	Miami	4,913,950
Arizona	4,200,000	North Butte	1,766,000
Cerro de Pasco	5,952,000	Old Dominion	2,814,000
East Butte	1,811,000	Shannon	827,000
Greene-Cananea	4,100,000	Shattuck-Arizona	842,790

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date	
May 8	6.65
" 9	6.65
" 10	6.65
" 11	6.65
" 12 Sunday	
" 13	6.90
" 14	6.90

Average week ending	
Apr. 2	7.19
" 9	7.13
" 16	7.00
" 23	6.95
" 30	6.83
May 7	6.78
" 14	6.73

Monthly averages

	1916	1917	1918
Jan.	5.95	7.64	6.85
Feb.	6.23	9.01	7.07
Mch.	7.26	10.07	7.26
Apr.	7.70	9.38	6.99
May	7.38	10.29	....
June	6.88	11.74	....
July	6.40	10.93	....
Aug.	6.28	10.75	....
Sept.	6.86	9.07	....
Oct.	7.02	6.97	....
Nov.	7.07	6.38	....
Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date	
Apr. 16	115.00
" 23	115.00

Apr. 30	115.00
May 7	110.00
" 14	110.00

Monthly averages

	1916	1917	1918
Jan.	222.00	81.00	128.06
Feb.	295.00	126.25	118.00
Mch.	219.00	113.75	112.00
Apr.	141.60	114.50	115.00
May	90.00	104.00	....
June	74.70	85.50	....
July	81.20	102.00	....
Aug.	74.50	115.00	....
Sept.	75.00	112.00	....
Oct.	78.20	102.00	....
Nov.	79.50	102.50	....
Dec.	80.00	117.42	....

Quicksilver in London is £22 ($105) per flask.

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918
Jan.	41.76	44.10	85.13
Feb.	42.60	51.47	85.00
Mch.	50.50	54.27	85.00
Apr.	51.49	55.63	88.53
May	49.10	63.21	....
June	42.07	61.93	....
July	38.37	62.60	....
Aug.	38.88	62.53	....
Sept.	36.66	61.54	....
Oct.	41.10	62.24	....
Nov.	44.12	74.18	....
Dec.	42.55	85.00	....

ORES

Antimony: There have been no developments and prices are unchanged.

Manganese: March imports were only 19,300 long tons, the lowest in over two years. This is perhaps indicative of the extent to which the Government is restricting shipments from Brazil; the situation is not encouraging. The extent of the falling-off in March is shown by the fact that the January and February receipts averaged 51,018 tons each, with the 1917 average at 52,498 tons per month.

Molybdenite: More interest is displayed, but it has not yet developed into much buying. Quotations are unchanged at $1.80 per pound.

Tungsten: Considerable activity is reported, with sales of various grades at the ruling price of $24 and $24.50 for high-grade ores and of $20 for others. Ferro-tungsten is unchanged at $2.25 to $2.35 per lb. of contained tungsten.

Eastern Metal Market

New York, May 8.

In general the markets are all quiet, though a little more activity is displayed in one or two, as well as a better tone.

Copper is in strong demand for May delivery, but the situation as a whole awaits price-fixing discussions in Washington.

Tin prices continue to soar to still higher record levels, with business of any account impossible.

Lead is quiet and lower.

Zinc is firmer, higher, and displays a better tone.

Antimony is more active.

In the steel trades buying for general use has stopped short, and the industry is devoting itself entirely to the big task set for it by the War Industries Board. There is still the belief that 60 days' concentration on war needs, and the appeal this may make to workmen to increase output, will relieve the situation in no small degree by July 1. The April pig-iron statistics bear favorably on the war steel situation, showing the largest month's output since May 1917. At 3,288,211 tons in the 30 days of April, production was at the rate of 109,607 tons per day, against 3,213,091 tons in March, or 103,648 tons per day, a daily gain of nearly 6000 tons. Of 2,200,000 tons of shell steel already allocated for 1918, shipments thus far amount to 1,500,000 tons. The year's orders on shell account are put at 5,000,000 tons.

COPPER

It was generally supposed that the meeting in Washington May 1 was between copper producers and the War Industries Board or its representatives, but it is now learned on good authority that such was not the case. The meeting was one for the discussion of the refining cost problem and was attended by only the representatives of the refiners. No details are obtainable as to what transpired or as to the attitude of the Government. This will develop later. It is known that refiners presented the situation from their point of view as to the mounting costs for refining, which are no doubt realities of a serious nature, and which are gradually eating into the profits because compensation for refining is based on the old contracts. The meeting will be continued on May 22, at which the copper producers will present their side of the case. The Government will then have all the facts before it on which to base a decision as to an advance over the 23.50c. copper price, which holds until June 1. No reduction is expected. Some trade-opinion is to the effect that, if the refining charge is increased, an advance in the other price will be necessary. Otherwise many small producers will not be able to pay a higher refining cost and make both ends meet. One instance is cited of a small producer who, under present conditions, turns out copper at 22.75c. per lb., leaving a profit of only ¾c. Another disturbing factor is the movement among copper laborers and miners for an advance in wages. Their representatives are soon to petition the Government for an advance claimed as necessary because of the higher cost of living. Demands of copper for May delivery are very large for Allied and American war needs, and there is some doubt whether these can be met in full. The price for copper in the jobbing market is 24.67½c. per lb. and the demand is fair but supplies none too adequate.

TIN

The situation goes from bad to worse, and there seems to be no relief in sight. Good news is meager. It seems probable now that sailings from the Dutch East Indies will be permitted, which will relieve the tension somewhat. In England the tin market has virtually been taken control of by the Government. To buy or sell tin there now permission must be obtained from the Government, and under these regulations the sales of a few parcels have been permitted to consumers in the United States for shipment from the Far East. The quantity involved, however, is small. In the last week little business has been transacted, and in fact but little could be done. Under present conditions no large business is possible. Prices have also continued to rise here and in foreign markets until unheard of heights have been reached. For spot tin of any grade as high as $1 to $1.05 would be paid were the metal obtainable, and for future delivery from the Far East for any position from 95 to 98c. is the quotation. In London a similar situation prevails. Spot Straits has again advanced to £20 per ton in the week to £381. Arrivals at Atlantic ports to May 6 inclusive have been 275 tons. In April the deliveries of tin from Pacific ports to the Eastern seaboard were 4495 tons, which, with the 550 tons arrived at Atlantic ports and the 64 in stock and landing on April 30, makes the total April receipts 5109 tons.

LEAD

Conditions are practically unchanged from those obtaining for the last few weeks, and the market is quiet. In fact the long dullness is regarded as queer because usually at this time of the year there is pronounced activity. Many large sellers continue to have no lead to offer, or else they do not care to meet the present prices. But there are a few sellers who continue to make offerings which seem to be more than the market can absorb. This has, of course, resulted in a lower level of prices, so that yesterday lead was quoted at 6.42½c.. St. Louis, or 6.62½c., New York, for early delivery. There is decided lack of interest, with the supply greater than the demand. The American Smelting & Refining Co. still maintains its price at 7c., New York, to the surprise of many.

ZINC

The market has taken a turn for the better, and the tone is more cheerful. One of the main reasons for this is the understanding that the Government has made large purchases of high-grade and grade-C zinc and is to make still more. It is expected even that these purchases will be such that some prime Western or similar grades will have to be re-distilled to meet the Government's needs. Another factor is the disinclination of some large producer to sell for future or even for nearby delivery at the present price-levels, at least in quantity. The higher price agreements for top-grade ore in the Joplin district, by which a $75 price is proposed, is also a bullish factor. Demand is not large, but there is more interest displayed. The market may be quoted for early and May delivery at 6.87½c. to 7c., St. Louis, or 7.12½ to 7.25c., New York, for prime Western with June delivery not less than 7c., St. Louis, or 7.25c., New York. For grade A the maximum price is 12c., and for sheet zinc, 15c. per lb. base.

ANTIMONY

Because of reported buying by the Government and by some others, the market has been more active recently, and is firmer at 13 to 13.25c., New York, duty paid, for spot and early delivery of Chinese and Japanese grades.

ALUMINUM

For No. 1 virgin metal, 98 to 99% pure, Government prices control the market. They range from 32 to 32.20c. per lb. in lots of 50 tons down to 1 ton.

Company Reports

Some silver producers at Cobalt, Ontario:

CROWN-RESERVE MINING CO., LTD.

Property: silver mines at Cobalt, control of the Porcupine Crown gold mine at Porcupine, and control of the Reward gold mine in Inyo county, California.

Operating Official: Harry Steward, general manager, since April 1918, Samuel Cohen previously.

Financial Statement: income from silver, etc., in 1917 was $265,155, less $182,582 for operation, leaving a profit of $82,573. Balance from 1916 was $773,587, and that carried to 1918 was $781,765. Receipts from investments, etc., were $73,920.

Dividends: none was paid last year, so the total remains at $6,190,849.

Development: total underground work in the Crown Reserve mine was 2798 ft. No discoveries of importance were made. In the Cochrane 938 ft. was driven on 550-ft. level, opening some high-grade ore. In the Silver Leaf some fair ore was exposed. The general situation made full capacity impossible at the Reward property. Porcupine Crown operations are reduced to development only.

Production: silver extracted from high-grade ore was 78,954 oz., and from mill ore 250,716 oz., a total of 329,670. To date the total is 19,960,676 oz. The cost was 55.6c. per oz., against 69.3c. in 1916, and 45.01c. in 1915.

KERR LAKE MINING CO.

Property: silver mine at Cobalt, Ontario.

Operating Official: H. A. Kee, manager.

Financial Statement: during the year ended August 31, 1917, ore sales realized $1,887,118, and interest $22,346, making a total revenue of $1,909,464. All charges amounted to $565,990, leaving $1,343,474 available. Surplus at September 1, 1916, was $1,033,570, and at August 31, 1917, $1,711,044.

Dividends: amounted to $666,000.

Development: new work covered 3105 ft., a decrease of 951 ft., due to labor shortage. This work was done in the more favorable portions of the mine. Some of it was disappointing. Reserves were not decreased to the full extent of the year's production, and are estimated to be 52,400 tons containing 898,900 oz., and 2,221,500 oz. in rich ore.

Production: 31,281 tons of ore treated by the Dominion Reduction Co. yielded 821,457 oz. silver, while 1,729,889 oz. was from shipping ore, a total of 2,551,346 oz. Cobalt in the high-grade ore amounted to 89,454 pounds.

LA ROSE MINES, LTD.

Property: silver mine and mill at Cobalt, Ontario.

Operating Official: G. C. Bateman, general manager.

Financial Statement: gross value of ore produced in 1917 was $371,584. All charges were $329,426, leaving a profit of $42,157, plus $29,090 from other sources, making a profit of $71,247. Balance at end of 1916 was $727,169, and at end of 1917, $509,927.

Dividends: amounted to $240,000, making $7,475,410 to date.

Development: the work in La Rose was largely unproductive. Operations were stopped at the Lawson mine. No estimates of reserves are possible. Most of the dumps have been milled.

Production: the mill treated 44,451 tons of ore assaying 8.75 oz. per ton; of which 83.3% was extracted. Shipments totaled 1501 tons, of which 1187 tons was concentrate containing 273.33 oz per ton. Silver production was 478,639 oz., making 24,205,968 oz. since 1908.

Costs: on a per ounce basis the total was 73.51 cents.

McKINLEY-DARRAGH-SAVAGE MINES OF COBALT, LTD.

Property: silver mines and mill at Cobalt, Ontario.

Operating Official: T. R. Funicane, manager.

Financial Statement: net value of ore produced in 1917 was $693,937. The total cost of production, including depreciation, was $394,810. With sundries the year's profit amounted to $259,795. The current surplus is $242,514.

Development: in the McKinley mine new work covered 4686 ft. in the lower levels. A considerable tonnage of ore was blocked out, but no large bodies of rich ore. Reserves are estimated to contain 1,076,182 oz., excluding the silver in 200,000 tons of tailing, for which a plant has been erected.

Production: the mill treated 68,142 tons of ore averaging 13.434 oz. per ton. Extraction was 86.98%, yielding 796,298 oz. Silver shipped amounted to 1,020,545 oz., making 17,260,202 oz. since 1906.

Costs: on a per ton basis, $6.934; on a per ounce basis, 57.09 cents. In 1916 the cost was 40.73c., in 1915, 28.71c.; in 1914, 31.32c.; and in 1913, 22.33c. per ounce.

NIPISSING MINING CO., LTD.

Property: silver mines and mills at Cobalt, Ontario.

Operating Officials: R. B. Watson, general manager; Hugh Park, manager; Jas. Johnston, mill manager; J. J. Denny, manager of research department; Chas. Butters, consulting metallurgical engineer.

Financial Statement: the gross value of silver produced in 1917 was $3,756,890, of which $2,686,472 was profit. Adding the balance from 1916—$1,980,127—there was available $4,666,599. After paying dividends the balance carried to 1918 was $2,731,598.

Dividends: payments last year totaled $1,935,000, making, with those in 1918, a total of $17,730,000.

Development: new work amounted to 10,002 ft., about the same as in former years. A number of small veins were discovered, contributing an appreciable share of the year's output. Nearly all stoping exceeded expectations, and the previously known limits of a number of veins were extended. Vein 490 is one of the main sources of ore. On No. 5 level the shoot is 690 ft. long, and on No. 6, 660 ft. long. The stope above this level should be from 8 to 15 ft. wide over an average height of 110 ft. Reserves consist of 3468 tons assaying 1350 oz. per ton, and 134,240 tons of 25.3 oz., making 8,076,540 oz. available.

Production: the high-grade mill treated 1172 tons (excluding custom ore) of ore assaying 1960 oz. per ton, and the low-grade mill (40 stamps and cyanide plant) 73,015 tons of 31.13-oz. ore. Extraction by cyanide in the latter plant was 80.64%. The yield in 1917 was 4,212,248 oz. Since 1904 there has been shipped 48,827,808 oz. of silver.

Costs: on a per ton basis, $14.26; on a per ounce basis, 25.117 cents. The latter is an increase of only 1c. over the previous year, a remarkable result considering conditions.

TEMISKAMING MINING CO., LTD.

Property: silver mine at Cobalt, Ontario.

Financial Statement: ore sales and bullion realized $864,774, plus $11,008 for interest, etc. Operations cost $331,440, leaving a profit of $544,342. Balance at credit at end of 1916 was $671,000, making available $1,215,342. After deducting dividends, etc., the current balance is $814,557.

Dividends: five of $75,000 each made a total of $375,000.

Development: 4896 ft. of work was done last year. The main shaft was sunk to 1600 ft., just below the diabase sill, but nothing was found like that in the Beaver mine adjoining. Generally, the mine outlook is not encouraging, so an option was taken on the Hohenauer claim at Kirkland Lake.

Production: 958,670 oz. of silver was extracted at a cost of 31.56c. per ounce.



INFORMATION FURNISHED BY MANUFACTURERS

PERKINS REGENERATIVE-FURNACE SYSTEM

By Walter G. Perkins

One of the most notable improvements in copper smelting consists in the adaptation of the regenerative principle to the modern reverberatory furnace as described and illustrated in an article in the 'Mining and Scientific Press' of June 2, 1917.

The advantages of Perkins regenerative system may be summarized as follows:

1. Lower total capital outlay per ton of capacity.

2. Increase of capacity per 100 sq. ft. of hearth area is 50%.

3. Saving in fuel-cost on the basis of smelting 550 tons per day equals: with coal at $6 per ton, $107,310 per year; or with coal at $7 per ton, $125,195 per year. If furnace capacity is increased to 800 tons per day, a further saving of 20c. will be made on labor and other costs.

4. Decrease in fuel consumption per ton of charge smelted is 50%.

5. Decrease in labor and other costs about 20c. per ton of charge smelted by increase of furnace capacity.

6. The non-reversing regenerative furnace is a complete economic unit within itself, as against the present practice of having an inefficient furnace with boilers attached, also inefficient, but necessary to the furnace, in order to make it an economic possibility as a smelting unit.

The economy of the above type of furnace over the present reverberatory, with and without boilers attached for utilizing waste heat is shown below, in the fuel calculations on the basis of 100 tons of coal per day (pulverized) containing 12,500 B.t.u. per lb., or fuel-oil of 18,000 B.t.u. value, the capacity of the furnace being 550 tons, 70 to 80% being hot calcine.

Case 1. A reverberatory furnace with waste-heat boilers attached, the final gases being discharged up the stack at 700 to 900°F.

	%	Coal, tons
Heat used in smelting	17	17
Heat saved in waste-heat boilers	35	35
Heat lost by radiation, chemical absorption, etc.	15	15
Heat lost up the stack	33	33
	100	100

Case 2. Reverberatory furnace, with Perkins non-reversing regenerative installation replacing waste-heat boilers, discharging gases up the stack at 300° to 400°F.

	%	Coal, tons
Heat used in smelting	17	17
Heat saved in regenerator and returned to furnace as pre-heated air	51	51
Heat lost by radiation, etc., in furnace	15	15
Heat lost by radiation in regenerator	5	5
Heat lost up stack	12	12
	100	100

Calculating the above heat-balances to terms of coal in pounds per ton of charge:

	Pounds
Case 1 requires	364
Less (35%) waste-heat credit	127
Net	237
Case 2 requires	364
Less 51% saved and returned to the furnace by the regenerators	186
Net	178

These figures show that where steam is of no value 49 tons of coal will do as much work as 100 tons, when a furnace is fitted with non-reversing regenerators, which saves 51 tons per day. This reduced to money means a saving as follows:

With coal at $6 per ton, $107,310 per year, or 53.2c. per ton.

With coal at $7 per ton the saving is $125,195, or 62c. per ton of charge smelted.

In cases where steam is credited at its full value, and allowing for that value, which is impracticable when using the regenerative system, the saving shows a complete waste of heat up the stack of 14 tons of coal per day, which is $6 per ton, or $30,660 per year; and at $7 per ton is $35,770 per year.

Furnace Performance. In regard to furnaces working with waste-heat boilers, every effort has been made to obtain their maximum efficiency, so that it can be assumed that the present practice is the best that can be done, when using air at atmospheric temperature for supplying the necessary oxygen for the combustion of the fuel. When, however, the air is heated to a high temperature, the condition is completely changed, and it then becomes possible to generate high-temperature gases and to increase the furnace capacity. Using cold air for combustion, the fuel ignites and produces a temperature of about 2700°F.; this ascends rapidly to about 3000° in the first 10 ft. of the furnace, which rapidly burns out the roof at this point, and then the curve abruptly descends so that the temperature at the throat of the furnace is about 1800° to 1900°F. This temperature is lower than that required to smelt or superheat the charge, consequently it is evident that the furnace ceases to smelt somewhere in the second third of its length. It is, however, necessary that the throat temperature should not exceed 1800° or 1900°, as a matter of fuel-economy, to keep down the stack-losses, as there is no further use for any heat-units that pass the boiler.

This condition is different when a furnace is working with the air regenerative system, as it becomes practicable to generate higher temperatures and to carry the heat the entire length of the furnace without reducing the fuel-economy, as the heat-units passing the throat are absorbed by the brick-work in the regenerator and are re-absorbed by the live-air en route to the furnace. This fact can be carried to absurdity, that is to the point of destruction of the furnace, as for instance, it is not practical to burn 100

tons of coal per day in a furnace with hot air that has a capacity of 530 with cold air, as the result would be:

$$\frac{\text{Case 2. 68 tons coal available for smelting with hot air}}{\text{Case 1. 17 tons coal available for smelting with cold air}} \times 550 = 2200 \text{ tons per day:}$$

that is to say, with a regenerative furnace burning 100 tons of coal per day it would smelt 2200 tons of charge, as against 550 using cold air for combustion.

There is, however, a point where a compromise can be made between cutting down the tons of coal, to the extent of not allowing the furnace to smelt more than 550 tons per day, and the point of absurdity above cited, which seems to be to bring the furnace capacity up to 800 tons per day burning 72 tons of coal. The resulting condition probably would be a furnace with a temperature of 3000°F. at the bridge-wall and about 2400° at the throat going to the regenerator, and with a final stack-temperature loss of about 300 to 400°F. This increase of furnace capacity would not be so hard on the repair bill as the short quick action of the cold-air method, as per the present practice. The furnace would smelt its entire length and, the skimming end being hotter, it would tend to decrease the slag losses, especially with a highly-aluminous slag, that requires a higher degree of super-heating to keep liquid. The same probably applies to basic slag. The increase in furnace capacity would also create two further economies, the lessening of capital-expense per ton of capacity, and the lowering of labor-costs per ton of charge smelted, besides the smaller economies that are hard to allocate. It seems, however, from estimates made that 20c. per ton of charge is not too high; therefore, the total financial position appears as follows:

Case 1. 550 tons charge per day, or 201,750 per year, with or without waste-heat boilers (no further economy).

Case 2. 880 tons charge per day, or $292,000 tons per year, at an economy in coal of 53.2c. at $6 plus 20c. labor, etc., saving 73.2c. per ton or $213,744 per year; or with coal at $7, 62c. plus 20c., or 82c. per ton, or $239,440 per year.

This shows that little can be done either to further increase the capacity or to lower the cost of operation in the present waste-heat boiler with cold-air practice, whereas with the hot-air regenerative system it is practicable to increase any furnace that now has a capacity of 550 up to 800 tons, and to reduce the cost of smelting per ton of charge from 73 to 82 cents.

Draft. In the present reverberatory practice, it is necessary to have a positive draft, as the air for fuel combustion has to be drawn in through holes in the back of the furnace; also the resistance offered by the boiler-tubes has to be overcome. This condition is entirely changed in regenerative work, as the heated air enters the furnace at a pressure balancing that used for blowing the pulverized fuel into the furnace, and which probably records about 0.5 in. of water inside the back wall of the ignition end of the furnace. Under this condition it is obvious that the stack has to do much less work; in fact, all that is required is that it should have enough pull to keep the regenerator clear of gases, for the slower the gases travel, both in the furnace and the regenerator, the better the efficiency and the lower the stack losses. At Kyshtim the gases going to the stack are 250°F.

Construction. Two estimates have been made in widely-separated points, one in careful detail. The first totaled $85,000 and the second $86,000, allowing for all contingencies. In cases where large waste-heat boiler-installations are connected with steam-lines to the power-house, there is no reason why a regenerative installation should in any way cause the abandoning of any existing work, as the boilers could at a comparatively small expense be equipped with their own firing system; this would enable them to be worked more economically by placing the baffles in their proper places, and thereby obtain the value of the heating surface of the boiler; also the waste-gases, which will probably leave the back of the boilers at 600° to 800°F., could be discharged into the regenerative system, and finally get up the stack at 300° to 400° F., which is about the temperature that would exist if the boilers had economizers attached.

The data given in this statement have been obtained with considerable care, representing average conditions. The heat-balance represents data gathered from three important copper-smelting plants working under entirely different conditions, and widely separated one from the other.

TREATMENT OF MOLYBDENUM ORES BY VOLATILIZATION

Now that there is an increasing and steady demand for molybdenite and the other ores of molybdenum, particularly for munition purposes, many mines which otherwise would have lain idle are being operated. This is true especially in Arizona where large deposits of the mineral are found accompanied with copper. Much difficulty, however, is being experienced in the concentration of such ores, because small amounts of copper and of some other elements are prohibitive. This difficulty seems to have been overcome by a Canadian metallurgist, F. D. S. Robertson, of Toronto, who has patented a simple process whereby the molybdic oxide is readily removed by volatilizing-roasting and is condensed directly from the ores, leaving the copper and the other elements in a condition fit for subsequent extraction in the ordinary way.

The ore, concentrate, middling, or tailing, containing the molybdenum, is crushed to No. 8-mesh, preferably through rolls, in order to preserve the flakes as much as possible and thus to expose a greater surface to oxidation in the furnace, into which it is charged in a dry condition. Of the various oxides of molybdenum it is most desirable to use an excess of oxygen so as to form the tri-oxide, MoO_3, which melts at a temperature of about 800°C. A reaction occurs according to the equation $MoS_2 + O_7 = MoO_3 + 2SO_2$, resulting in the formation of fine silky acicular crystals. These are exceedingly volatile, and therefore are sublimed. Under these conditions of temperature and atmosphere this oxide alone is produced. A recovery of 95% of the molybdenum content is effected, particularly from the so-called amorphous molybdenite, and in some cases a higher proportion is obtainable. The enhanced value of such a pure product, coupled with the fact that it is a dry process, compared with ordinary molybdenite concentrate, warrants the use of this process in preference to oil or other methods in vogue. Pure ductile molybdenum may be obtained readily from such molybdic-acid crystals by heating at a dull heat in a current of hydrogen gas. Commercially pure molybdenum is quoted at about $36 per pound (in quantity), but delivery is scant. Metallic molybdenum is now taking the place of platinum in many of its applications.

COMMERCIAL PARAGRAPHS

The Grasselli Chemical Co. has moved its New York offices from 80 Maiden Lane to the Equitable Trust Bdg., 347 Madison avenue, at the corner of 45th street.

The National Lead Co. has re-elected the former directors, namely, R. R. Colgate, C. E. Field, Walter Tufts, G. D. Dorsey, and F. M. Carter. This company is a large owner of the stock of the U. S. Cartridge Company.

The Norton Co. of Worcester, Massachusetts, has issued a pamphlet, illustrating and describing machinery and methods for grinding cutters, reamers, drills, taps, dies, and lathe-planing machine tools. Recommendations as to the grains and grades of wheels required are included.

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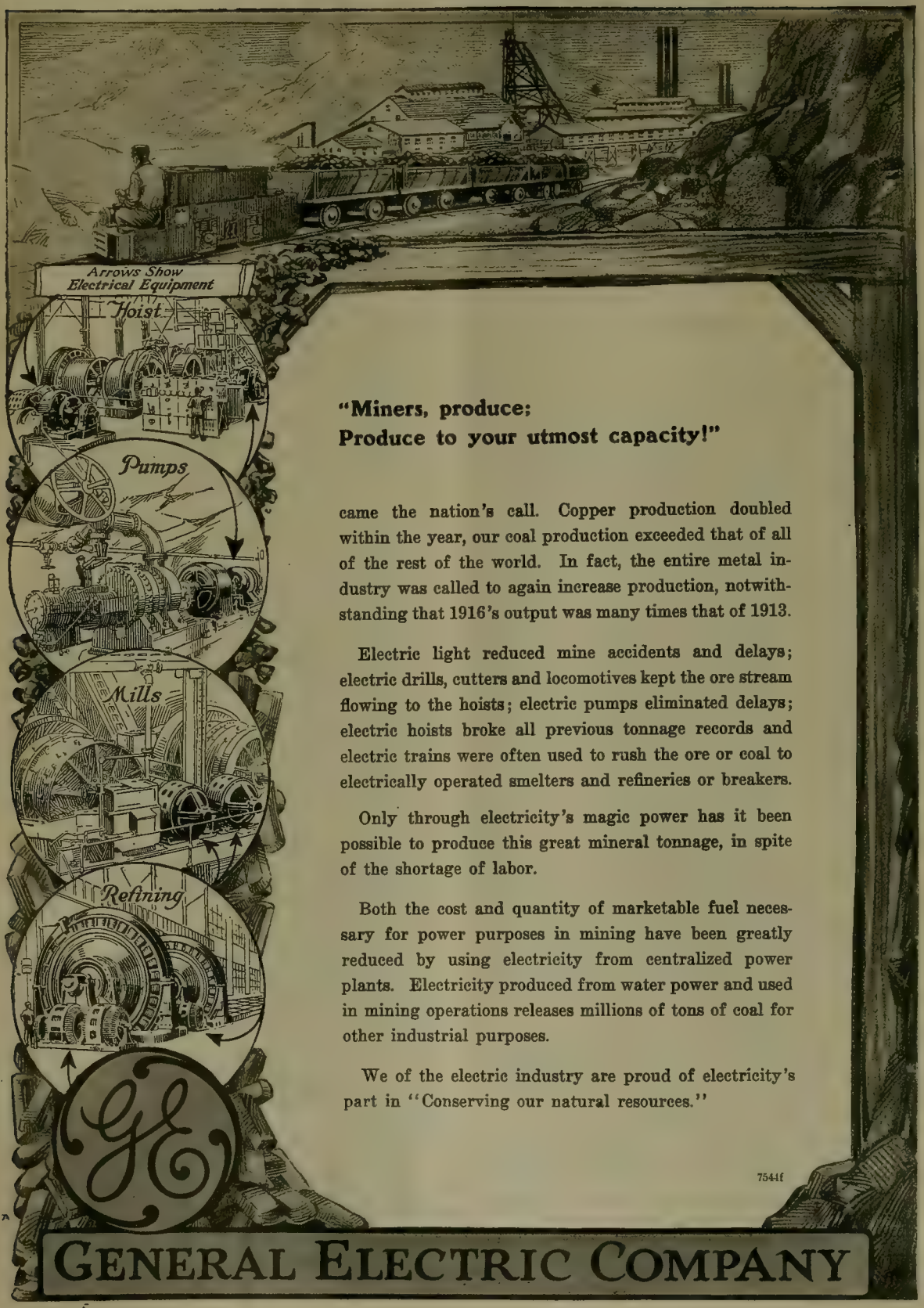
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**"Miners, produce:
Produce to your utmost capacity!"**

came the nation's call. Copper production doubled within the year, our coal production exceeded that of all of the rest of the world. In fact, the entire metal industry was called to again increase production, notwithstanding that 1916's output was many times that of 1913.

Electric light reduced mine accidents and delays; electric drills, cutters and locomotives kept the ore stream flowing to the hoists; electric pumps eliminated delays; electric hoists broke all previous tonnage records and electric trains were often used to rush the ore or coal to electrically operated smelters and refineries or breakers.

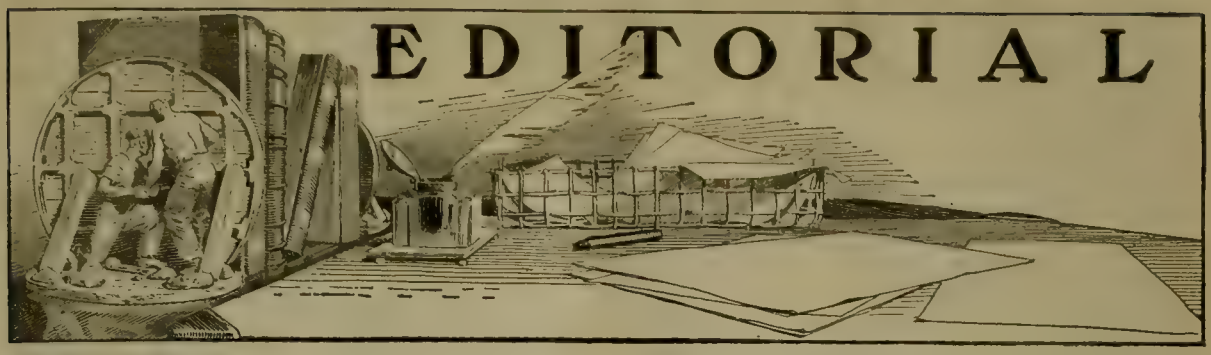
Only through electricity's magic power has it been possible to produce this great mineral tonnage, in spite of the shortage of labor.

Both the cost and quantity of marketable fuel necessary for power purposes in mining have been greatly reduced by using electricity from centralized power plants. Electricity produced from water power and used in mining operations releases millions of tons of coal for other industrial purposes.

We of the electric industry are proud of electricity's part in "Conserving our natural resources."

7544f

GENERAL ELECTRIC COMPANY



EDITORIAL

GERMAN officials in Belgium have tried their best, for four years, to kill 'La Libre Belgique', the irrepressible spokesman for Belgian independence. Recently it was announced by the German administration that the editors, publishers, and printers of this brave little paper had been arrested and sentenced, one of them to death. The next morning a copy of the paper was in its usual place in the letter-box of Baron von Falkenhausen, Governor-general of Belgium. 'La Libre Belgique' still appears—irregularly, it is true—but it is kept alive by the indomitable spirit and energy of a few courageous and persistent patriots. We salute our gallant contemporary!

A GROUP of 15 small producers of copper, representing an aggregate output of 75,000,000 pounds per annum, has formed a committee to ask for relief from the Government. These producers insist that they are an important factor in the total output; that those experiencing like difficulties constitute, in fact, a good-sized army, and that they are not able to produce copper at less than 30 cents per pound. They affirm that they have been operating at a loss in expectation of higher prices, rather than close their mines and suffer the further loss that always follows upon idleness of plant and disorganization. They are proposing a sliding scale of selling prices based on the cost of production as a feasible method of meeting the difficulty.

WE note that our New York correspondent comments upon the proposal to change the name of the Institute so as to specify metallurgy as one of the arts to which it is devoted. The idea has something to commend it, and our correspondent says so clearly, but we confess ourselves unsympathetic. If metallurgy is to be specified, then geology also should be mentioned. All the geologists that are members of the Institute are not mining engineers, but many engineers are geologists. No name to be given to the Institute can cover all the abilities and aptitudes of the profession. A mining engineer plays many parts, he must know something about many sciences, he necessarily is not a narrow specialist. The mining engineer is all sorts of an engineer. The objects of mining are to find, win, and beneficiate minerals and ores. To do that the engineer of mines must be a geologist, a miner, a metallurgist, a merchant, even a financier. No greater name exists in the annals of American engineering than that of Alexander Holley, who shed lustre upon the Institute by serving as its President for a year. He is the supreme type of the mining engineer; he was a great miner, a great chemist, a leading hydraulic engineer of his day, and the most distinguished metallurgist this country has produced. It seems unwise to change the name of the Institute, now established by 47 years of useful service.

PROCEEDINGS now in progress at Chicago against the ring-leaders of the I. W. W. are almost overlooked in the midst of the stirring events of the day. It is well to call attention to the fact that the trial has conclusively proved that the organization was directing its efforts toward the closure of mines by fomenting strikes in a nation-wide conspiracy to hamper the United States in its plans for war. Enormous quantities of posters in three languages were distributed by the I. W. W. throughout the country, urging the laborers to strike and in other ways to impede the nation's preparation to resist Germany. The Teutonic influence appears in many forms, at one time in that of the rabid dynamiter posing as the representative of honest labor, and at another sentimentally whimpering for peace in the name of Christianity.

IN the editorial columns of the 'Financial Times', we find some highly interesting comment on the presidential address delivered recently by Mr. H. F. Marriott before the Institution of Mining and Metallurgy. Our contemporary in London declines to accept Mr. Marriott's "discovery" that there is no "general indication of depreciation of the gold values at depth" on the Rand. The Johannesburg correspondent of the 'Financial Times' points at the fact that the current market quotation of nine relatively young Far-Eastern Rand mines exceeds by several million pounds sterling that of the forty other productive mines on the Rand and asks "if the cause is not mainly deterioration of the Central Rand in depth, what is it?" We agree with this criticism, of course; we go so far as to say that Mr. Marriott's disingenuous treatment of the subject is not convincing, and was not convincing on other occasions when he has adverted to it, for it is unscientific; in short, it is too plainly a special plea made in the interest of the stock-market, the history of which, during the last ten years, proves

pitiably how the public has been misled by the financiers of the Rand and by their subservient henchmen. We shall return to the subject at an early date in order to discuss it with the thoroughness that its importance deserves.

KITCHENER is said to have remarked, "This is a war of machines, not a war of men." This sets forth one of the insistent aspects of the great struggle, although it is to be noted that today, as ever, the machine has to be directed efficiently if it is to be effective. The man behind the gun has not lost his essential importance. It was said recently by a British officer returning from the front that 80% of the work along the line of battle is engineering and 20% fighting. A little thought confirms the truthfulness of this generalization. Apart from the making of munitions and the equipping of armies, it is evident that the enormous masses of men now engaged in fighting call for a scientific organization of transport, the making of wagon-roads, the building of temporary railways, the erection of huts and hospitals, besides the digging of trenches, shelters, and saps. So necessitous is this work of engineering that it has been found advisable to have men of engineering training not in special regiments but in every battalion, even in every company, so that at the pinch there may be somebody to show how to construct or destroy field-works, or otherwise direct the jobs that are bungled by those not possessing the special experience required in a hurry. In this war of nations it has been discovered that the civilian soldier holds an advantage over the man of purely military training in that he possesses iniatives and aptitudes acquired only in the pioneer life of the miner, the backwoods-man, or the cattle-ranger. The mining engineers in the British army have distinguished themselves greatly by bringing to bear the special knowledge gained in the waste places of the earth. Our own engineers have already begun to prove their practical usefulness amid circumstances that evoke the fullest use of that trained common-sense that we call 'gumption' because we dislike to apply to it the more pompous term 'science.' It is pleasant to think therefore that the miner and the profession associated with him will play a greatly honorable part in the tremendous struggle in which 27 nations are now engaged, not only in producing the metals urgently needed for the munitions and machines of war but in contributing a world-wide experience to the assembling and directing of the immense apparatus required to overcome the outlaws of civilization.

The Flotation Appeal

The metal-mining industry of the United States is to be congratulated on the outcome of the appeal made by the Butte & Superior Mining Company against the decision of the Montana court in the suit brought by the Minerals Separation company for infringement of patent and for damages. We give the full text of the opinion handed down by the United States Court of Appeals for the Ninth Circuit. The decision of the Montana court is reversed, and the defendant company is released from a permanent injunction against the further use of the agitation-froth method of flotation. The opinion is written by Judge Ross, a Virginian jurist of fine classical and legal training, who also sat in the Hyde case; he is supported by Judge Hunt; while Judge Morrow concurs in the reversal of the decree of the lower court, but not "in the direction that the bill be dismissed." He does not agree with his two other colleagues in limiting the scope of the patent to the use of less than one-half of 1% of oil on the ore. For that is the keynote of the decision. Both litigants used the Supreme Court's decision in the Hyde case in their argument; they could not do otherwise; similarly the Appellate Court accepts the decision of the higher court; all it can do is to apply that decision to the case at issue. Judge Bourquin, of the Montana District Court, interpreted the Supreme Court's opinion in a manner that we thought illogical, and this view is confirmed by the reversal of Judge Bourquin's decision by the Appellate Court. The Supreme Court confirmed the validity of the Minerals Separation patent, but, recognizing how small had been the step taken by the Minerals Separation metallurgists in their improvement of the flotation process as disclosed by prior patents, they confined the Minerals Separation patent to results obtained by the use of oil within the critical proportions, as described in the claims of the patent and in the testimony on record in the Hyde case. Unfortunately, the Supreme Court did not go further, as it might have done, and state specifically what the 'critical' proportion was, that is, the Court did not state whether it was a definite fraction of 1% or exactly 1% of oil on the ore; hence the starting of the new litigation in which the Butte & Superior Mining Company became defendant as soon as it refused to accept the Minerals Separation interpretation of the Supreme Court's decision. The Supreme Court held the patentees to *a* fraction of 1%, not *every* fraction, says Judge Ross, for the Supreme Court accepted the evidence showing that granulation ceased, and flotation was complete, when the proportion of oil was reduced to 0.5%. The colloquy between Mr. Justice McReynolds and Mr. Kenyon is quoted by Judge Ross. It seemed to us highly significant at the time it appeared in the record of the case, and we noted its effect when it was read in the court-room during the proceedings on appeal. Judge Hunt quotes the specification in the patent setting forth that from 0.02 to 0.5% is a suitable proportion of oil for the process. From the evidence in the case, he concludes that the critical proportion is "very nearly one-tenth of 1% or two-tenths of 1% as may be required for a particular ore." Judge Morrow considers that if the Supreme Court had intended to confine the scope of the patent to a proportion of oil not exceeding 0.5%, it would have said so explicitly. Much of the testimony referred only to the use of oleic acid on Broken Hill ores, says Judge Morrow, therefore the scope of the patent was not confined by the Supreme Court to 0.5%, but was left open for the use of various proportions up to 1%, and inasmuch as the defendants "keep out of the

limits made for the plaintiff by the decision of the Supreme Court by using more than the critical proportion, they do not use plaintiff's process." This confirms the judgment of those that thought they could escape the claims of Minerals Separation by using more than 20 pounds of oil per ton of ore. The Court of Appeals holds that the patent (No. 835,120) does not cover the use of any particular kind of oil, and therefore that when the defendants are using kerosene or any other fuel-oil they are doing only what the patent authorizes, provided the proportion used is beyond the critical point, which is less than half of one per cent. However, the Court has made a curious blunder in assuming that the Butte & Superior Company "has never used in its process any oil in quantity as small as one-half of 1%," as stated by Judge Ross. The fact is that the appellant only began to use the non-infringing proportion of oil last year, as frankly admitted in the pleadings. The decree has just been modified in accord with this fact, thereby making the Butte & Superior liable for infringement from the beginning of its milling operations to January 7, 1917. At the present time the Butte & Superior, Utah Copper, and Chino companies are using over 10 pounds per ton, while the Ray uses less, but in connection with the air, not the mechanical agitation, method of flotation. The distinction drawn by Judge Morrow is interesting. We have directed attention, more than once, to the fact that the early experiments and several of the patents, notably No. 835,120, were based upon the use of oleic acid, a thick heavy oil quite unlike the frothing-agents now generally employed. The use of a thick oil like oleic acid was inherited from the Elmore process, for which heavy viscous oils were supposed to be best suited. Many statements concerning flotation with oleic acids are incorrect and misleading if applied to later work in this branch of metallurgy. That is why the series of experiments on which patent No. 835,120 is stated to have been founded is so unconvincing to those recently attracted to the study of the process. The fact is that, of course, Messrs. Sulman and Picard, of Minerals Separation, knew very little concerning the practical operation of the process when they applied for patent in 1904 and therefore they made a number of erroneous assumptions that have been crystallized in the course of litigation. Even today this latest decision of the courts and the record of evidence in the case lag considerably behind the technology of the subject. While experts and counsel argue about the efficacy of particular oils and assume the necessity for using some quantity of oil, some fraction of 1%, it is known to our readers that a 93% recovery of copper as chalcopyrite has been made with plain sea-water, without the aid of any kind of addition-agent. It seems queer to be disputing as to the proportion of oil that is 'critical' when no oil whatever is required in the flotation of some ores at least. The restriction of the patent to less than 10 pounds of oil is of the greatest importance, and it is one that seems to us wholly in harmony with the dictum of the Supreme Court. Therefore we expect it to be confirmed, if, as is likely, a writ of certiorari be granted for a final review of this case before the Supreme Court.

We have wondered often why the Hyde case was allowed to come before the Supreme Court after the Court of Appeals in San Francisco had given its decision; we conclude that the writ of certiorari was granted in deference to the British courts, quoted, quite mistakenly and improperly, in the Hyde case. The British decisions did not bear upon the matter at issue; they dealt with the validity of the older bulk-oil patents of Elmore, not the Minerals Separation patents. Again, it is not recognized generally how nearly the Appellate Court at Philadelphia reversed the Delaware decision in favor of the Miami Copper Company. Apparently the minority opinion was the majority decision until Judge McPherson changed his mind, as is suggested by the use of 'we' where 'I' would fit better in the context. We mention this fact to indicate how fortuitous the dicta of the courts have been and how important this latest, and we believe, penultimate, decision is destined to be to the mining industry.

The Real Sinews of War

The world is now persuaded of the fallacy in the argument of the ante-bellum pacifists that there was a financial limitation to the ability of nations to carry on war. It is now seen that resources in men and in the products of the earth constitute the only limitation that controls a determined belligerent. We had grown so used to having our individual rights protected by the State, and had so long regarded a government of the people as being a servant of the people that we overlooked the fact that by its very nature a competent government must be sovereign. Indeed, we had forgotten the meaning of the word 'sovereign' and the fact that absolutism inheres even in the power established by the choice of free electors. Our readers must have been impressed by the good-natured indictment of the people of the United States in the cogent remarks by Capt. R. Hodder-Williams in our issue of May 4. He characterized us as an undisciplined nation. He gave a thrilling example of what discipline means, of the confidence that gives men the courage to rush forward in the face of death, and win, knowing that their comrades are disciplined and can be trusted to follow. This illustrates the moral quality that lies in discipline, the moral quality of a supreme duty. We were reminded that duty is the keynote of discipline. We had too much looked upon it as mechanical, for when it merely restrains the freedom of a people, as it does in Germany, it reduces man to a machine and destroys his initiative, which is the hope of all free and representative government. We had overlooked the necessary association of duties with the rights and privileges of citizens in a progressive democracy. Even the duty to study public affairs and to express our convictions at the polls had been shirked by an alarmingly great proportion of the voters. We are learning useful lessons from our experience in the hard realities of war. It is necessary to remind ourselves that the financiers are not the controlling influence in the councils of war, so that we may better interpret the true meaning

of the statistics of national finance. Some there are who still tell us that Germany is bankrupt, and consequently that she must soon weaken. It is important for us to remember that bankruptcy will not bring any government to its knees as long as it has men and material resources, and enjoys the confidence of the people. It is probably true that the morale of a country will suffer when normal business disappears, as it must when the credit-limit has been reached, yet Mexico went through just such a crisis, despite which a basis of domestic exchange has been evolved sufficient to encourage a moderate resumption of industry. The will to fight did not vanish even in the face of a fiat currency that had nothing behind it but guns and decrees. The same result might follow in a country that had been used to financial operations and industrial activities of great magnitude.

The strain of war upon the credit resources may be compared to the elongation of metal. It is not the tensile strength alone that must be considered, for that limit may soon be passed. The question is how far the metallic basis can be stretched before rupture ensues. When that happens the function of banks of issue has been superseded by the fiat of the supreme authority compelling the acceptance of inconvertible paper in all business transactions. At the outbreak of the War, for example, the ratio of gold and silver to the total note and deposit liabilities of the banks in France was 59.5%, and by January of this year it had diminished to 13.7. This is a severe decline, but not enough to destroy public confidence in the stability of the current medium of exchange. In Italy the ratio was 64.3%, and it has fallen to 11.5%. Great Britain makes a better showing with a ratio of 39.4% in June 1914, against 27.5% in January 1918.

A like comparison is not possible with the United States, as we did not enter the War until April 1917, and the pressure upon our resources may be said only to have begun. Our metallic reserve against note and deposit liabilities was still strong at the beginning of this year, being 61.7%. It is in Austria where the pinch has been felt most sharply, the decline having been precipitous from 63.4% to 1.1%. This indicates a financial instability that must be accompanied by great increase in prices, and it may help to explain the evident timidity of Emperor Charles and the peculiar tone of the utterances of Count Czernin on several memorable occasions. Austria undoubtedly is bound by financial and other bonds to Germany so that she cannot pretend to be in any sense a free agent, but warrant is found in these conditions for President Wilson's belief that she would be glad to find some avenue of escape from her dilemma. Meanwhile her debt has risen from $3,985,000,000 in 1914 to $15,000,000,000 at the present time. It is clear that she has not been permitted to profit from the loot and tribute obtained by Germany. In fact, although an ally in name, she has been fettered by financial chains clamped upon her by her Prussian masters. The debt of Germany has augmented from a pre-War figure of $1,165,000,000 to $24,243,000,000, yet her banking conditions have not suffered proportionately. The ratio of gold and silver to her total note and deposit liabilities has decreased from 36.7 to 13.3%, while the gross metallic reserves have actually grown from $363,700,000 to $615,292,000. In Austria the reserves have dropped from $311,963,000 to $64,657,000. Apparently the precious metal has flowed in a steady stream from Vienna to Berlin. It is interesting to note that the countries not actually participating in the War generally have strengthened their financial position. Spain has more than doubled her metallic reserve, so that today she boasts a ratio to outstanding obligations of 71.5%. Holland has made proportionate gains, though the actual volume of increase in the gold reserve has been only about half as great. Sweden, Denmark, and Switzerland have all suffered, apparently because of propinquity to Germany, entailing the necessity for conducting an immediately unprofitable commerce with their threatening neighbor. Japan has been nominally in the War, but has not been using up her resources as have the powers with whom she is allied. She has benefited by her relations with all of them except Russia. The metallic reserve underlying the notes and deposit-liabilities of her banking system have risen from $112,296,000 in 1914 to $326,982,000 at the present time, constituting ratios respectively of 41 to 46.6%. As a creditor nation she has greatly strengthened her resources, despite the uncertain value of the $85,000,000 loaned to Russia. She has advanced $140,000,000 to Great Britain, and $38,000,000 to France. Furthermore, the total volume of deposits in Japanese savings banks has been larger than her internal loans negotiated during the War. The financial strength of Japan has become the chief factor in the adjustment of affairs in the Far East. The extension of the privileges acknowledged first in the Lansing-Ishii agreement she has further confirmed through making the other powers her debtors, in which she has not failed to include China. On the opposite side from this example of liberty to augment her prestige and financial influence, accorded by the Allies to one of their number, is the case of Austria looted to the point of helplessness by the imperial nation to whose hopes of victory she is absolutely essential. The economic weakness of Austria, however, must not be taken to imply that she can be detached from the fortunes of Germany. She has become her vassal, and will so remain until Germany's man-power has been exhausted. Germany's financial status will not wreck the Prussian, for indebtedness does not argue lack of resources. When, however, the real sinews of war in men and supplies become reduced too low for further resistance then the economic distress in Austria will hasten her downfall. Meanwhile we must regard any statement of banking difficulties in this or in any of the Allied countries as having no significance regarding our ability to wage a conquering war. Our strength lies in our inexhaustible resources in supplies and in men, all of which, and all of whom, our quickened perceptions of duty now show us belong to the sovereign State we have erected as a united people in willing discipline for the common good.



The United Verde and Labor

The Editor:

Sir—My attention has been called to an article that appeared in your issue of April 6, wherein you comment upon matters as you found them in Arizona during your visit there last year. I believe that, in regard to many of these matters, you have been misinformed, and I hasten to correct any wrong impression that you may have had.

In the first place, in regard to the strike in the Jerome district, which was in the latter part of May 1917, you make the statement that it was your belief that this strike could have been avoided, if the United Verde Copper Co. had used firmness and fairness in its dealings with the men. I have active charge of the United Verde, and the facts in regard to the strike are as follows:

I was in New York early in May, and at that time knew there was something in the air in regard to a demand for increase of wages, etc. I took up the matter with my assistant, Mr. Tally, at Jerome, and wired him finally to put into effect the Miami scale of wages, believing that it was better to have a uniform scale in Arizona, although our scale at that time was approximately the same as the Miami. About a week after this I was waited on by a committee consisting of Moyer, president of the Western Federation of Miners, Lord, Cannon, and Burns. They were with me about two hours and their plea was for the closed shop. This I absolutely refused, and the matter stood in this way until the latter part of May, when the strike was declared at Jerome. Thanks to about 300 Mexicans, who refused to go out, and to the efficiency of our underground bin system, we were able to continue operating during the two weeks that the strike lasted, although, of course, on a reduced scale.

The Governor of the State, the representative of the War Department, and the representative of the Department of Justice were in Jerome during this strike. The strike ended by the men coming back to work on exactly the terms I had offered before they struck and when their demands were first made, and that was by my allowing a grievance committee to be appointed, but by my refusing the closed shop. I cannot see that there was any lack of firmness here.

Your comments in regard to the physical conditions of Jerome itself are true. It is unfortunately located on a steep hillside, which makes building very difficult, so that it is, I admit, an unsightly point. However, so far as we are concerned, we have endeavored to make it as livable as possible for our men. We had, at the time of the strike, about 80 houses which were rented to our men, and I have since built 30 more at Jerome. These we rent at a price so low that our real estate account for the last 15 years has always been a losing one. It is true that rents, generally, in Jerome are very high, and the reason for this is as follows:

When the United Verde Extension mine developed into such a fine producer, there were many 'wild-cats' started at Jerome, and the town, within a short time, doubled its population. People who owned houses, regardless of whether they were mere shacks or not, took advantage of this situation to raise their rents, and I have been informed that a number of strong union men were among those who owned shacks and took advantage of this situation. We, ourselves, continue to rent our houses to the men at the same prices as before, and that is from a third to a half of what others charge.

So far as actual living expenses in Jerome are concerned, the recently appointed Federal Administrator for Arizona, Mr. Joseph Myers, made a thorough investigation and report, and his findings were, that living costs at Jerome were as cheap as in any camp in the West, and cheaper than in most of them.

You refer in your letter to the rather uncomfortable railway terminal, and this is admittedly so, the main reason being that we have been obliged to put our station away back on the hillside in order to prepare for the large steam-shovel operations which we are now about to undertake; but, as a remedy for this, we are constructing now a road from the mouth of the Hopewell tunnel, to which point our Verde tunnel and smelter railroad connecting at Clarkdale with the Santa Fe runs, to a point at Jerome, which will greatly facilitate passenger and freight traffic.

You intimate in your statement that a shorter road to Prescott could be built, but you must be aware that this would be a physical impossibility. We have always been anxious to have a closer business relation between Jerome and Prescott, and for this reason I recently offered to finance, with the United Verde Extension, a fine automobile-road connecting the two points.

I should have been pleased, while you were at Jerome, to have shown you our town of Clarkdale, which is admittedly the finest smelter town today in the world. The buildings are beautifully built, the business houses are attractive, the school is most modern in every way, and everything in the way of hygienic precautions has been taken to insure as near a perfect condition of health for the inhabitants as is possible. Being within about half a mile of the smelter, where the stack is 400 ft. high, the

smoke has at no time within the last two and one-half years that the smelter has been in operation, caused the slightest trouble.

Our relations with our men now are most amicable. I believe that our men, as a whole, are peaceable and yet, in this great crisis, most patriotic. I will state that during the recent Third Liberty Loan drive, without extra solicitation on our part, every man in the employ of the United Verde Copper Co. purchased a liberty bond, and the average was about $80 per man. Considering the fact that we are about 70% foreign in our make-up, I consider this a wonderful record.

Your article was taken advantage of by the 'Arizona Labor Journal' to create a false impression concerning conditions at Jerome, and I think that, in justice to Senator Clark, who has operated in Jerome for thirty years, and generally in the West for about fifty years, during all of which time there has been but one strike on any of his properties, and to myself and my associates, I should set forth exactly what the facts are.

CHARLES W. CLARK.

San Mateo, California, May 17.

[We are most willing to give Mr. Clark an opportunity to make this courteous criticism. The writer of the article—the editor of this paper—did visit Clarkdale and is glad to testify to the excellent arrangement of that smelter settlement. It is all that Mr. Clark says of it. Of course, the writer was not aware that it was "a physical impossibility" to build a road to Prescott, otherwise he would not have made the suggestion, which came to him from one supposed to be thoroughly well informed. In regard to the events preceding the strike and the general treatment of the men employed by the United Verde company, we accept Mr. Clark's correction, with pleasure.—EDITOR.]

Extraction and Recovery

The Editor:

Sir—In metallurgical operations there is considerable confusion in the correct use of these terms. If a gold or silver-mining company report that its 'extraction' last year was 95%, it means that the bullion actually 'extracted' was 95% of the original metal-content of the ore.

If a copper company report 71%, it means that by concentration there was 'recovered' 71% of the original metal. Probably when the concentrate is smelted, the total actual 'extraction' would be under 70%.

The 1917 report of the Kennecott Copper Corporation states that the total average milling 'recovery,' including ammonia leaching, was 89.4%. This is correctly stated.

In describing the New Cornelia leaching plant, L. D. Ricketts said that the 'recovery' was nearing 80% of the copper-content of the ore. In wet-chemical methods of treatment, such as the one described, the 'extraction' of the metal from the ore by means of a solvent is not to be confused with 'recovery'; and the calculation of percentage recovery is the basic factor on which considerations of ultimate success or failure can alone be gauged.

Concentration at Burro Mountain is reported to have 'saved' 72.258% of the copper. This means 'recovered' not 'extracted.'

In describing the concentration of carnotite ore, Bulletin No. 103 of the U. S. Bureau of Mines says: "As much as 63.7% of the carnotite contained in the milling ore was 'extracted,' and 60% of all the carnotite in this ore was actually 'recovered' in the concentrates (four grades), on the basis of the uranium content determined by chemical analysis. In this statement 'extraction' is considered as the difference between uranium oxide content in the feed and in the tailing, whereas 'recovery' is considered as the actual uranium content in the concentrate expressed as a percentage of the uranium content in the feed.

M. W. VON BERNEWITZ.

San Francisco, May 17.

Treatment of Tungsten Ores

The Editor:

Sir—I believe I can contribute something to those interested in mining scheelite ore. When I came into the Atolia and Randsburg districts about three years ago I found all the mills crushing with stamps or ball-mills. Now scheelite and other tungsten ores are in the shape of crystals, and these when pulverized will 'flour'. To granulate is evidently the proper thing. Accordingly, for a crusher I got the Moyle roll jaw-crusher; then I put in a set of rolls, with a shaking-screen under both the crusher and the rolls. It proved best not to crush finer than 20-mesh. After looking over the field I got an Overstrom 'Universal' concentrator-table, and the Hamill ore-feeder. When I put that before the concentrator, I increased the output two tons in eight hours. I am now getting a recovery of better than 85%. The completed mill did not cost more than $4000, and it treats an average of 30 tons in 24 hours.

The conditions of the tungsten market also deserve a word. At present it seems that there are no buyers in the field. What is the cause? Is it that the Government is going to set a price and take it out of the hands of the brokers, or is there an over-supply? I read in the papers that the Government was going to try loaning money to the small mine-owner and prospector, to encourage greater activity in mining and a larger output. That is not the main difficulty. What we want is to get a steady and reliable market for our tungsten, say, at a price of about $30 per unit, and the prospectors, leasers, and mine-owners will get busy and will not need financial assistance from the Government. Just fix a fair price and we will do the rest. With the cost of powder and wages and living as they are we must have a price for the output that will enable us to run, or we will have to shut-down. I can count 25 properties now that are idle on account of the slump in the price; we are now offered only $20 per unit for ore assaying 65%, or better.

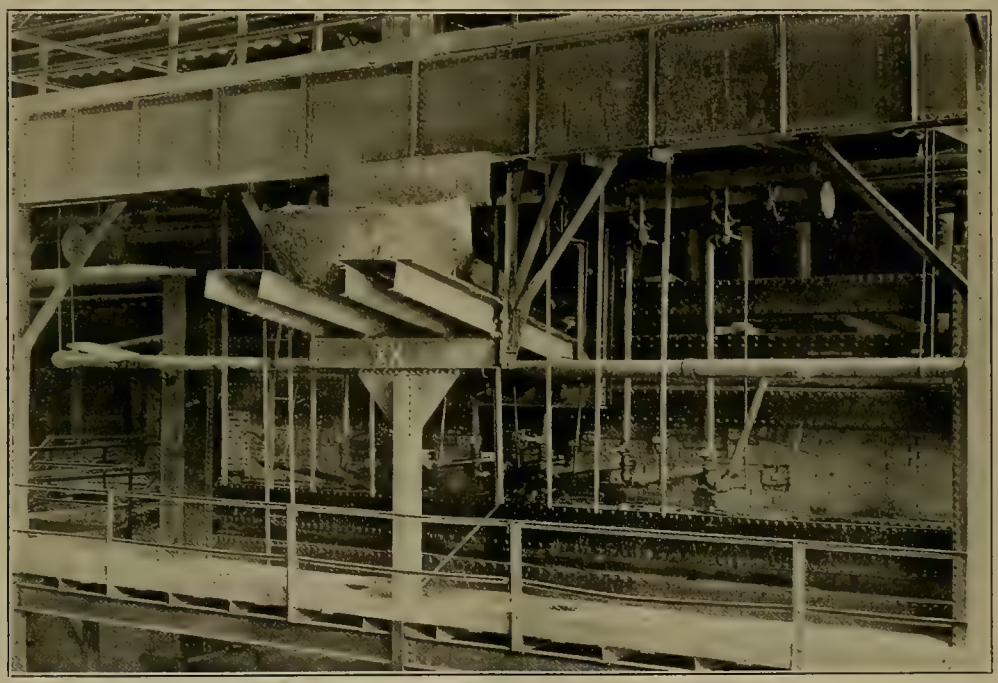
J. H. RATCLIFFE.

Randsburg, May 15.

Smelting Methods at El Paso—II

By COURTENAY DE KALB

COPPER SMELTING. The copper department of the plant contains four reverberatories and four blast-furnaces. The latter are 144 by 44 in. at the tuyeres, and 14 ft. high from the sole-plate to the top of the water-jackets at the feed-floor. The hearth is of cast-iron with a 6-in. fire-brick lining. The tuyeres are 3½ in. diameter, and the blast-pressure is 2½ to 3 in. of mercury. The rate of smelting per furnace averages 275 tons of charge per day, with 10% coke. The copper content varies from 6 to 12%. The slag-type aimed at is approximately as follows:



OIL-BURNERS, SLAG LAUNDER, AND GATE LEVERS OF No. 4 REVERBERATORY FURNACE

Typical Analyses of Copper-Slags

	%	%	%
FeO + MnO	38.6	38.7	42.0
SiO_2	39.1	36.0	36.1
CaO	11.2	13.3	10.5
MgO	0.5	0.5	0.5
Al_2O_3	7.4	7.0	6.8
Cu	0.48	0.42	0.50

The relatively high copper in the slag as shown in the foregoing analyses is the result of so running the furnaces as to produce a high-copper matte, which in these cases contains about 45% copper.

The products of fusion from each pair of furnaces are discharged through a special sheet-copper spout, shaped and riveted at the plant, 2 ft. 6 in. long by 1 ft. 6 in. deep, water-jacketed, as shown in the accompanying illustrations, and fitted with a cast-bronze nose. The composition of the bronze is 98.5% copper and 1.5% tin. The spout lasts for years, but the wear of the running matte and slag cuts out a nose in six or eight months. From this spout the slag and matte empty into a round forehearth in front of each furnace, this being 14 ft. diam. by 4½ ft. deep, made of $\frac{7}{10}$ in. steel sheet. These hearths are lined on the sides with 9-in. magnesite or chrome bricks backed with 4 in. of fire-brick, leaving a 2-in. space between the brick wall and the steel shell, which space is filled with brasque, that is, a mixture of fire-clay with about 3% of coarsely granular coke. This forms an excellent non-conductor. To a slight extent the coke is consumed, thus helping to protect the brick wall from cooling, but it chiefly serves to relieve the strain from expansion, since the coke, while fairly resistant, will crush under the pressure. The bottom, also of steel, carries a layer of sand followed by a course of 9-in. fire-brick placed on end. At the matte-tap, and under the overflow spout, the magnesite is materially thicker. The

matte, which has an average content of 45% copper and 21% sulphur, is tapped into ladles and taken to the converters.

The reverberatory plant presents features of larger interest. There are three in operation and a fourth just entering service. These are working mainly on Chino concentrates, both from flotation and from table concentration, the ratio being about one to five. Typical analyses of these are given below:

Chino Concentrates

	Flotation concentrate %				Table concentrate %			
	1	2	3	4	1	2	3	4
SiO_2	24.7	22.8	26.5	25.9	9.4	14.2	21.5	13.4
Insol.	35.6	31.9	37.5	38.0	13.3	17.7	28.4	17.2
FeO	20.7	13.2	20.4	19.5	47.8	36.0	23.7	43.6
Cu	19.3	21.9	19.7	19.8	10.8	26.7	28.1	12.3
S	13.7	8.7	14.0	12.3	36.4	16.2	13.2	29.0

The oil-flotation concentrate presents some difficulties in roasting. The oil and moisture cause agglomeration, decrepitation is prevented, and unroasted kernels come to the reverberatory-feed, some of them having had a diameter as great as 4 inches. The outer one-eighth to three-sixteenths of an inch will be roasted; inside of this shell will be another of darker color, and about three-eighths of an inch thick; while the centre will be raw. It is highly probable that the agglomeration may in part be produced by an excess of alumina. The table concentrates also have caused trouble from the large amount of magnetite that they sometimes carry, but some of this mineral is now being removed at Chino with magnetic separators. The water in the concentrate when it is delivered to the drying-hearth of the Wedge roasters ranges from 4 to 18%, and regularly averages 10%. Even the first hearth serves also as a dryer, and samples from the ports of that hearth contain appreciable amounts of moisture.

Roasting is done in a battery of eight Wedge furnaces, with five hearths each 21 ft. 6 in. diam. Four new 7-hearth furnaces are being added. The speed of the roaster-arms is regulated by resistance-coils under control of the furnace operator, and the time of revolution varies from one in 21 to one in 59 seconds. With Chino concentrate the capacity of each furnace is from 155 to 175 tons per day. The sulphur in the feed to the roasters is usually about 14%, though at times it runs above 20%, and the elimination is only from 5 to 7 units. Therefore the calcine issues quite hot, the lower hearth showing a temperature of about 1000° to 1200° F. Auxiliary heat is applied with three to four oil-burners on the first and third hearths. In order to make the desired 45% copper matte the following ratios are maintained in the feed:

Ratio of copper to sulphur	1:1
Ratio of copper to iron	2.14:1
Ratio of copper to base	1.2:1

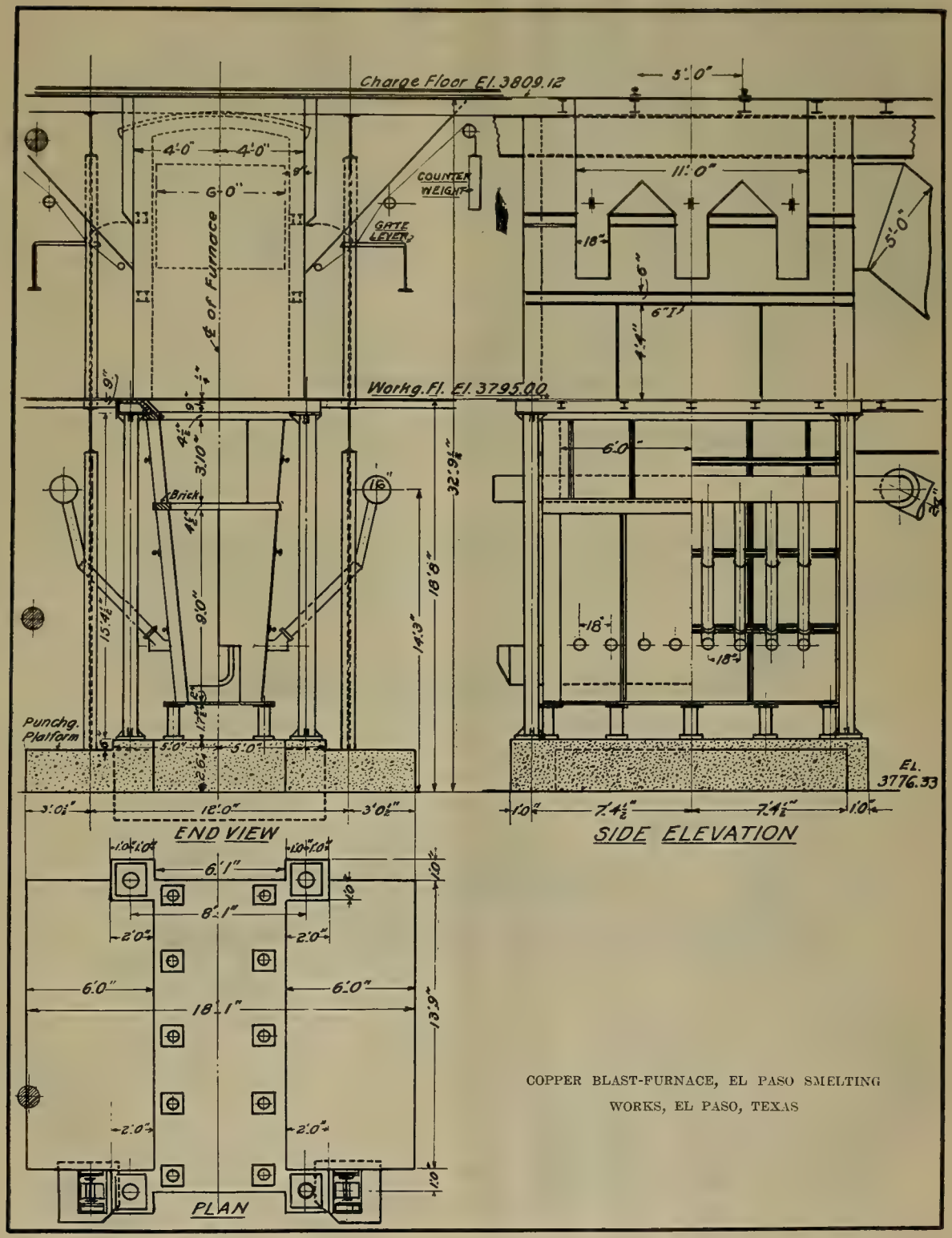
The Chino concentrate is nearly barren of precious metals, the average content being about 0.02 oz. gold and about the same quantity of silver. With such small quantities the percentage of losses, of course, is high. From other mixtures more precious metal enters the matte, which usually contains about 0.04 oz. gold and 2 to 6 oz. silver. For comparison it may be well to mention at this point that the precious metal in the anode plates shipped to the refinery averages, at the same period of sampling, 0.20 oz. gold and 12 oz. silver. However, these anodes represent a mixture of blast-furnace mattes higher in metals. Reverberatory-slag samples range in composition between the percentages given in the annexed table:

Reverberatory-Slag Analyses

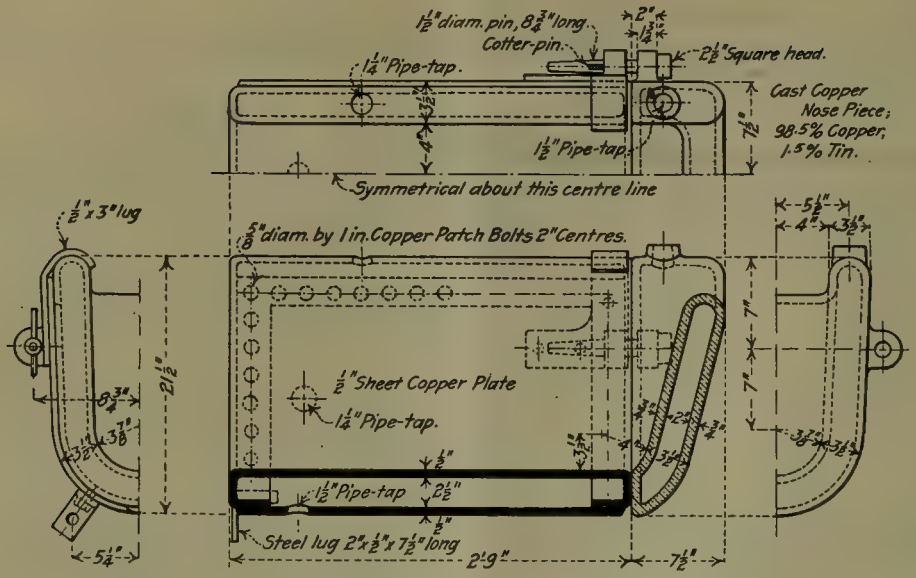
	1 %	2 %	3 %
Silica	36.9	38.7	41.3
Iron (FeO)	42.0	40.5	39.0
Manganese (MnO)	0.5	0.7	0.5
Lime (CaO)	6.5	6.5	5.8
Zinc oxide (ZnO)	0.8	1.0	0.9
Alumina (Al_2O_3)	8.4	6.6	8.3
Copper (when producing 30% matte)	0.32	0.34	0.38

The oxygen ratio, therefore, fluctuates between the limits of 1.5 and 1.25, or between a sesqui and a uni-silicate. This is not highly basic for a reverberatory slag, though its relative viscosity is quite evident from the rather steady content of copper at 0.35% or a trifle higher. The blast-furnace copper-slags average 37% SiO_2, 38 FeO, and 11 CaO, which is a bi-silicate, with an average copper content of 0.46%. In the reverberatories, with the mixtures now smelted, fluctuation of the silica seems to exert no effect on the copper or silver, but with too low a silica content an exceedingly viscous zone rich in copper and magnetic iron forms in the slag just above the matte-line. Increasing the silica dissipates it by taking up FeO from the Fe_3O_4, and then the further reduction of the Fe_2O_3 takes place. A similar effect is observed upon the increase of temperature, whereupon the magnetic iron disappears. This, however, cannot be maintained for any lengthy campaign, as the brickwork cannot long withstand such high temperature.

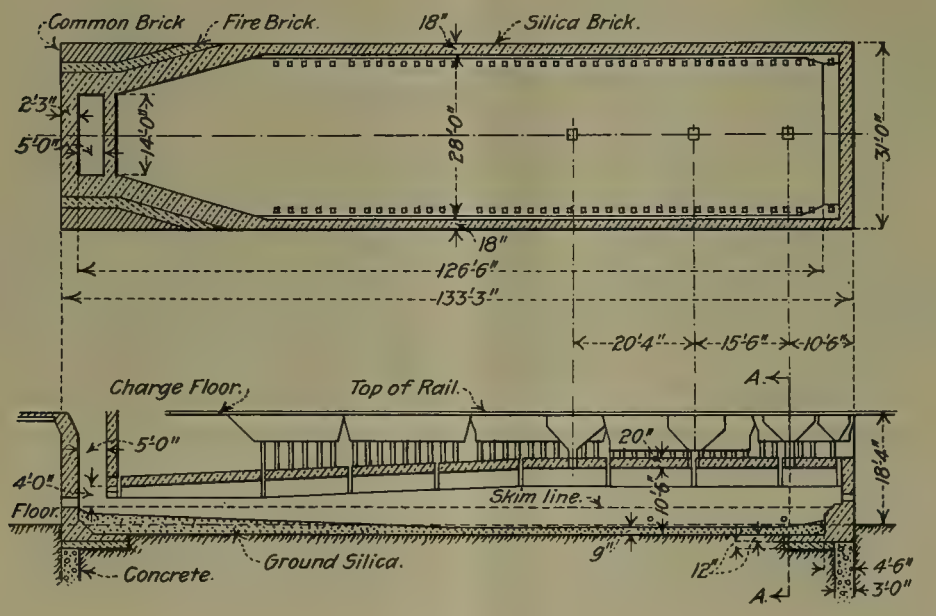
Of the reverberatories now under heat two measure 104 by 19 ft., and another 118 by 25 ft., while the new one is 130 by 30 ft. These are equipped with a battery of 11 Erie boilers in the flues to generate steam from the waste heat. The new furnace is designed in accordance with the plan for feeding used on the 118-ft. furnace, which is now becoming general in reverberatory practice. This is to omit fettling, in the old sense, and merely to feed the calcine and ore along the two side-walls of the furnace. Many years ago at Cananea, under the administration of L. D. Ricketts, this logical system was used in the form of feed-holes in the roof of the furnace just inside the walls, and through these holes silicious ores were fed as fast as the bank that dammed the slag from the wall was consumed. It is curious to realize how slow we are, after all, to think the next necessary thought. Today the maximum part of the charge is fed through ports on the side, just as silicious ore was fed as a fettling at Cananea 10 years ago. There is this difference, however, which marks a further advance in the art; instead of being held by the force of ancient

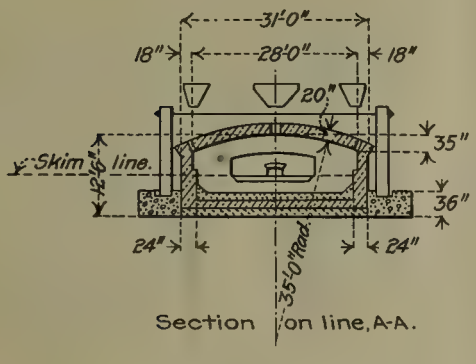


COPPER BLAST-FURNACE, EL PASO SMELTING WORKS, EL PASO, TEXAS

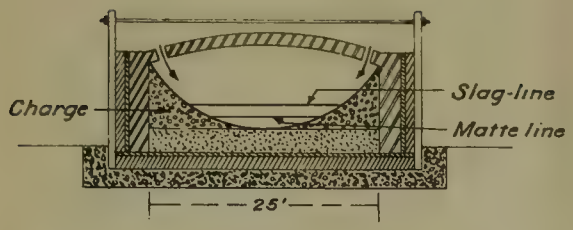


SLAG-SPOUT FOR COPPER BLAST-FURNACE





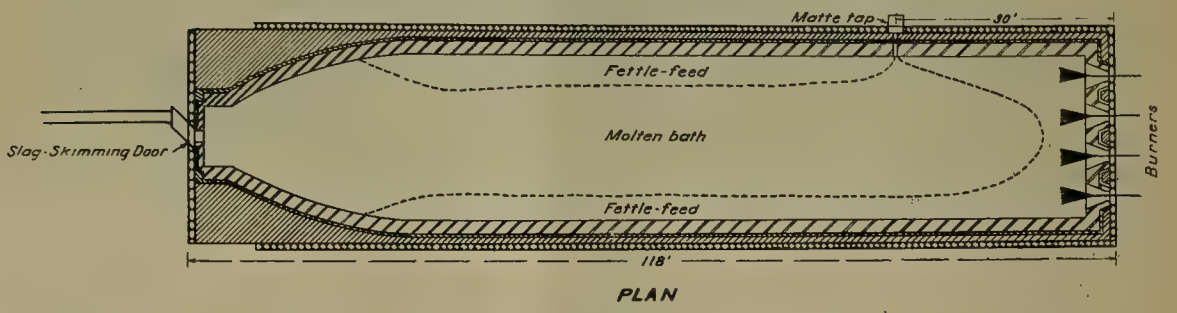
NEW REVERBERATORY FURNACE, No. 4,
EL PASO SMELTER



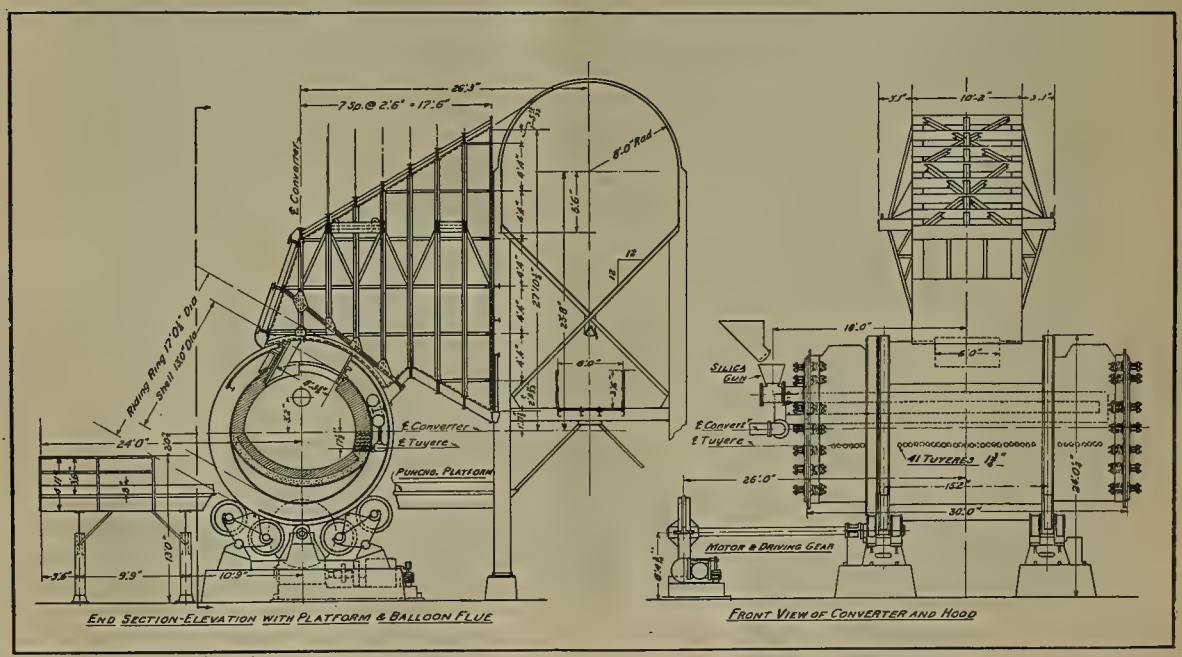
FETTLING-BANKS IN SIDE-CHARGING



DETAIL OF CHARGING SYSTEM, No. 4 REVERBERATORY



SKETCH TO SHOW OUTLINE OF BATH WITH SIDE-CHARGING



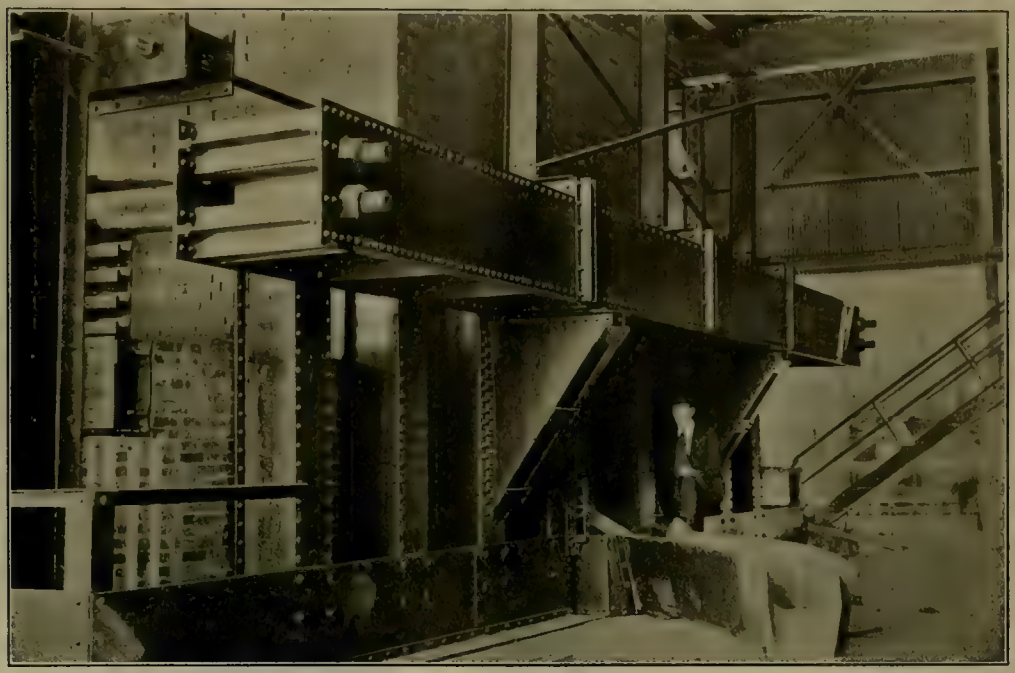
CYLINDRICAL COPPER CONVERTER AND BALLOON FLUE, EL PASO SMELTER

custom to maintain a low bank of ore, as was done at Cananea, following the conventional idea of fettling, the charge is fed freely, and is piled high along the walls. The furnace is accordingly widened to admit of these banks, which gives to the laboratory the shape shown in the accompanying cross-section. Moreover, this protects the walls, adding to the life of the furnace, and it prevents radiation of heat, thus introducing fuel economies, which cheapen the cost of the copper produced. Not only does it protect the walls against cutting out from fusion, but it overcomes the destructive effects of expansion and contraction when feeding, skimming, and the like. Some feeding is still done through charge-ports in the centre of the roof, since this is necessary for regulating the smelting conditions, but the charge is introduced chiefly through the side-ports. Charging is done from the rear of the furnace through two-thirds of the distance toward the front, the remainder being fettled with silicious ores, also introduced through side-ports. The molten bath always displays a tendency to eat into the wall, now at one place and now at another. As the conditions of feed and the sweep of the flame undergo changes the bath responds, and refuses to conform to the geometric design of the furnace. The method of fettle-feeding, as it may be called, gives flexible walls to the molten bath, so that it may accommodate itself to the changing conditions without doing damage to the furnace. The illustration shows in outline the vagaries of the bath within its sloping walls of reacting ore. The swing of the molten lake always makes a bay toward the matte-tap, which never becomes obliterated, and it also widens toward the skimming-door. Once every hour and a half to two hours the slag is skimmed, while the matte is tapped as often as necessary, depending on the speed of smelting and the copper content of the charge. The normal rate of smelting in the 118-ft. furnace has been 450 tons of charge per diem. Recent improvement in the detail of operating has increased this to about 675 tons of solid charge, with an oil-ratio of 0.72 bbl. consumed per ton smelted after giving credit for heat-recovery in steam produced. As the material going to the furnaces has not been as favorable for rapid work as usual, it would seem likely that a still larger average capacity will be attained. This striking gain has been achieved by localizing the smelting zone, that is, by so regulating the oil and air as to prevent the flame extending beyond the first 50 or 60 ft. of the furnace, and at the same time by limiting the charging to the first 60 or 70 ft., leaving the remainder of the hearth to constitute a pool where the matte settles from the molten charge. The temperature at the skimming end of the furnace, about 12 ft. from the up-take flue, under these new operating conditions, varies between 1950° and 2300° F., which is approximately the same as that registered before when the flame was allowed to sweep practically through the full length of the furnace.

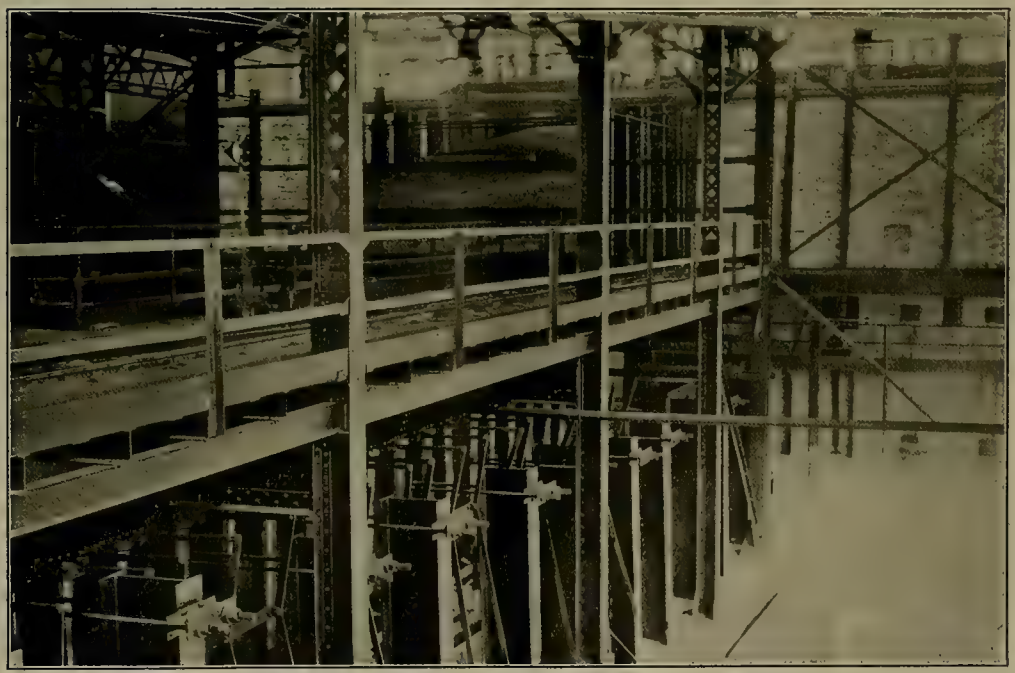
CONVERTING. The Great Falls type of convertor has been superseded at El Paso by the Pierce Smith barrel-type. All trace of the jug-shape is gone; even the bellied-form has disappeared. On the exterior it appears like a large horizontal cylinder, 30 ft. long and 13 ft. diam., with a flaming mouth in the position of a bung. Actually there is a 'false shell' opposite the mouth, cutting off a segment on a larger radius for the true bottom of the converter, thus making it flatter below, and reducing the depth of the molten charge within. The outer shell, under this segmental bottom, has large holes cut through it, permitting escape of heated air but also conserving some of the heat. The result of this arrangement is to overcome the tendency to form bottom-accretions, the brick lining seldom accumulating a layer thicker than three to five inches. The basic-brick lining is a magnesite brick 32½ in. thick on the ends, 18 in. on the rear semi-circle, and 13 in. on the front, leaving the effective inner dimensions 24 ft. 7 in. long by 10 ft. 5 in. diameter. There are 41 tuyeres in a row on the rear side, with the centres 14 in. below the estimated level of the bath when blowing. The depth of the bath varies from 40 to 60 in. The blast-pressure is 13½ to 14½ lb., and the volume of free air delivered per ton of copper is from 170,000 to 200,000 cu. ft., depending on the grade of matte being blown. The main supply of matte comes from the reverberatories and averages about 30% copper, while the blast-furnace matte carries from 40 to 50%. A full converter-charge of 30% matte is 225 tons, which will yield about 60 tons of blister. The initial charge of 30% matte is 64 tons. This initial charge consists of four ladles of 16 tons each. Then one or two more is poured in every 50 minutes, the converter being skimmed before each fresh addition of matte. An interval between successive charges of one-half hour to one hour is necessary for cleaning tuyeres, stack, and the like. This, however, is good practice, as it allows the hardening of the brick, which becomes slightly plastic under prolonged heat, due to the finish-blow, thus greatly prolonging the life of the lining. A record of one of these big converters, before repair of the lining was needed, is a remarkable example of the efficiency that is being attained in this branch of copper smelting. The total days' run, not counting lost time, was 318, and the blister-copper produced was 22,530 tons. At the end of this campaign the following magnesite bricks were all that the converter required to equip it for renewed service:

Kind	Size, in.	Number
Keys	13	42
"	18	470
"	9	200
Wedges	9	63
Splits	9	70
Rectangular brick	4 by 4 by 18	430
" "	2 by 4 by 18	130
Magnesite cement		5200 lb.

The above result is particularly noteworthy, considering the irregularity in the quality of the matte incident upon custom-smelting. With a more uniform matte the life and corresponding output of the converter would be greatly increased. There are two stands of these large converters and one of the old Great Falls type, 12 ft. diam. The silicious ore is fed into the large



FRONT OR SKIMMING END OF No. 4 REVERBERATORY



FRONT END OF CHARGE-FLOOR AND UP-TAKE FLUE, No. 4 REVERBERATORY

cylindrical converters by a Garr gun, which is a cylinder attached to the upper segment of the shell through which silicious ore is blown into the converter by an air-blast. The ore, crushed to 1½ in. and smaller, is delivered into the path of this blast from a small feed-hopper. It has proved a great economy, and causes no disturbance in the condition of the bath as does intermittent charging. The silica is added as it is needed by the oxidizing iron. The same attachment is being adapted to the Great Falls converter now in use at this plant. It is to be observed that copper metallurgists are not disposed to regard the type of converter as being more important than the right proportion of size to the amount of matte to be converted. A small converter in a plant may be extremely useful at times when the reverberatories are low in matte, by giving greater flexibility to the operation. The converter-fume is drawn into a balloon-flue of 250 sq. ft. sectional area, and 400 ft. long, connecting with a stack 300 ft. high and 16 ft. diameter at the top. The temperature of the gases entering the stack is about 300° F. The blast is supplied to the converters by two Nordberg blowing engines and one turbo-blower. The blowing engines are rated respectively at 18,000 and 12,000 cu. ft. of free air per minute delivered at 14-lb. pressure per square inch. The turbo-blower, rated at 30,000 cu. ft. of free air per minute, is a turbine at each end, the driving-turbine taking exhaust from other engines supplemented by live steam at 140-lb. pressure, the air being delivered against 14 lb. per square inch at the altitude of 3800 ft. above tide. It runs at 3350 to 3650 r.p.m., and registers 2000 brake horse-power. The steam-turbine is made by the Ridgway, Rateau-Smoot Co. of Ridgway, Pa., and the blower-end by the Rateau-Battu-Smoot Co. of New York. The converters are operated by the usual rack and pinion movement driven by a 75-hp. Shaw & Co.'s motor, and the shifting of ladles, shells, and other burdens is accomplished with a 60-ton 90-ft. span Shaw overhead crane, with auxiliaries, one of 30-ton and the other of 15-ton capacity.

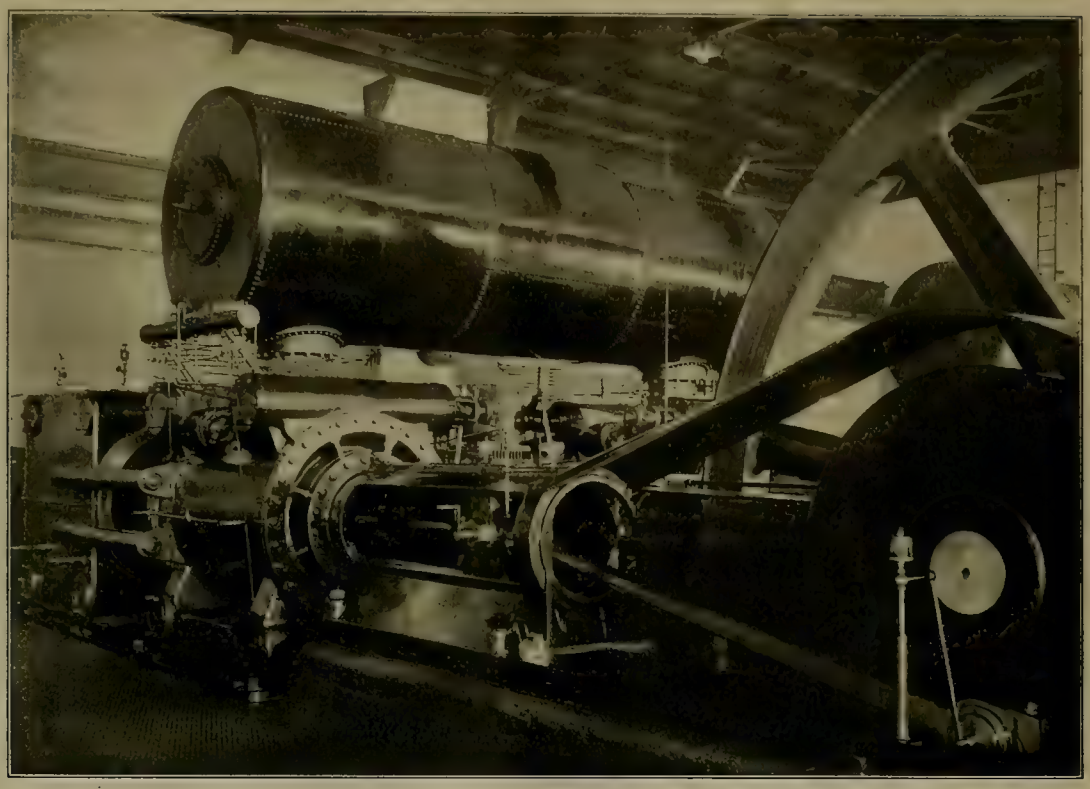
Refining. The molten blister copper is poured into ladles, and these are emptied into one of a pair of 145-ton tilting furnaces. These furnaces resemble in some respects an open-hearth steel-converter. The hearth-frame is of steel resting on wheels adapted to the curved bearing-bars, and is tilted for skimming and casting in the same manner as the converters. The hearth is lined with magnesia brick, and the top is a flat magnesite-brick arch, with low brick walls, all securely ironed. The inner laboratory dimensions are 8 by 30 ft. The receiving-spout or charging-door is placed centrally at one side just above the hearth, while the pouring-spout for the copper is opposite, and at a slightly lower level. The furnaces are oil-fired, and consume a total of 24 to 30 bbl. each per day. At one end is a work-door set in the brick wall, through which the copper is further refined by poling in the old-fashioned way for reducing the cuprous oxide and for expelling the dissolved SO_2. For this purpose green quaking asp poles, brought from Cloudcroft, New Mexico, are employed. The poles are 30 ft. long, 8 in. diam. at the butt, and tapering to 4 in. at the small end. For refining the output of 4500 tons of copper per month about 388 poles are required. The copper is poured into a cement-lined hydraulically operated tipping-spoon and thence into a revolving casting-machine, making anode plates 2 in. thick and weighing 725 lb. each. The molds are of similar refined copper, having an iron splash-plate cast into them at the point where the stream of copper will fall. These molds are cast at the El Paso smelter. The anodes are shipped to Baltimore for electrolytic refining. The complete analysis of the anodes shipped is approximately as follows:

	Analysis
Copper	99.6 to 99.75
Lead	0.02 to 0.025
Nickel	0.057 to 0.062
Arsenic	0.0064 to 0.01
Antimony	0.0056 to 0.011
Sulphur	tr. to 0.01

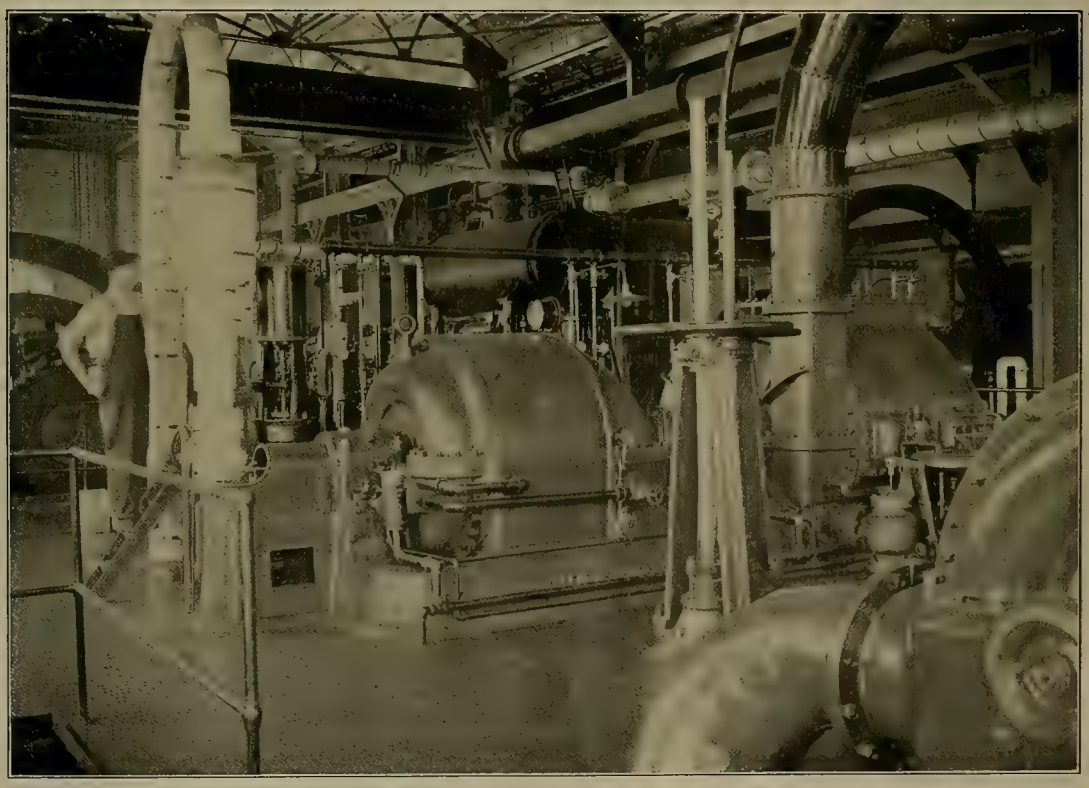
Dust-Losses. From the converter plant the total gas passing out of the stack is about 230,000 cu. ft. per minute. The dust-losses from the lead furnaces, as already explained, have been reduced by the use of the draft-hoods. The gas from the lead furnaces is combined with that from the copper blast-furnaces at the stack. The total volume of gas, reduced to 70° F., is 150,000 cu. ft. per minute. This is carried by an octagonal brick stack 225 ft. high and 15 ft. diameter at the top, discharging into the air at a temperature of 160° F. At a height of 60 ft. above the base, the gases have a temperature of 200° F. At this point the gases are sampled by drawing off a measured volume by a suction-blower giving the same speed to the sample as the velocity of the gas rising in the chimney. A tube 3½ in. internal diameter by 12 in. long is fixed centrally in the stack in a vertical position, with the open end turned downward. This is connected by long-sweep reducing-elbows to a 2-in. pipe projecting through the wall, and connected to an experimental filtering-bag. The dust gives a neutral reaction, but in wet weather corrosive compounds are formed that rot the cotton filter-bag.

The general manager of the El Paso smelter is Kuno Doerr. The general superintendent is J. Heggie. The lead plant is in charge of the assistant superintendent, C. W. Badgley, while the copper plant is operated under the direction of A. F. McCormick, assistant superintendent. The plant is operated on a highly economic basis, despite the disadvantages of an inconveniently crowded site and methods of handling that seem crude in these days of automatic devices, but that are the necessary consequence of local labor conditions and of a custom business that gives no opportunity for delays in remodeling. It is a plant where careful management and ingenuity are of prime importance.

Copper produced in the United States in 1916 from ores in which this metal constitutes the principal value totaled 1,969,403,226 lb. This was extracted from 57,863,365 tons of ore, which averaged 1.70%. The gold and silver value of this ore was 42 cents per ton.



NORDBERG BLOWING ENGINE AT EL PASO SMELTER



RATEAU-BATTU-SMOOT TURBO-BLOWER. CAPACITY 30,000 CU. FT. FREE AIR PER MINUTE AT 14 LB. PRESSURE

Minerals Separation v. Butte & Superior

OPINION U. S. CIRCUIT COURT OF APPEALS

This is an appeal from the decree of the United States District Court for the District of Montana, sustaining Letters Patent No. 835,120, issued to Sulman, Picard, and Ballot on November 6, 1906, for a process of ore concentration, and adjudging the appellant herein to have infringed the same.

The appellees, two British corporations and one domestic corporation, are the legal owners of the title to the patent in suit, and of the rights to profits and damages for infringement thereof. The appellant is a domestic corporation, doing business at Butte, Montana, where the acts of infringement complained of were committed.

The suit was commenced on October 10, 1913, and a preliminary injunction sought. At the hearing on the motion for a preliminary injunction the pleadings and proceedings in the suit of Minerals Separation, Limited, et al, v. James M. Hyde, in the United States District Court for the District of Montana, were offered and received in evidence, and are a part of the record herein. That suit was upon the same patent and the issues were substantially the same as in the present case.

The answer of the defendant set up the defence of anticipation, and denied infringement. While the cause was at issue, but before trial on the merits, the Supreme Court of the United States rendered its decision in the Hyde case (242 U. S. 261), holding Claims 1, 2, 3, 5, 6, 7, and 12 of the patent to be valid, and Claims 9, 10, and 11 to be invalid.

The plaintiffs filed a supplemental and amended bill on May 1, 1917, during the trial of the case on the merits, pleading a disclaimer filed by them on March 28, 1917, and charging continued infringement of Claims 9, 10, and 11 of the patent, as limited by said disclaimer, and of the remaining claims.

To the plaintiffs' supplemental and amended bill of complaint defendant filed its answer on May 4, 1917, denying infringement and the validity of the patent by reason of lack of novelty and invention; alleged, further, that the patent had become wholly void and invalid by reason of the unreasonable neglect and delay of the plaintiffs to file a proper or any disclaimer in writing to Claims 9, 10, and 11, held to be invalid by the Supreme Court in the Hyde case; alleged, also, an estoppel against the claim of infringement by the use by the defendant of an amount of oil exceeding five-tenths of one per cent on the weight of the ore, basing this defence upon a statement made by one of plaintiffs' counsel in the Supreme Court of the United States in the Hyde case, that the invention described in the patent was not reached or practised until the amount of oil fell to or below five-tenths of one per cent on the weight of ore treated by the process.

Upon the issues thus presented voluminous testimony was taken upon all the questions involved, which, as stated, were substantially the issues in the Hyde case, re-stated and re-considered by the lower court in the present case.

The Court thereupon entered a decree in favor of the plaintiffs, in accordance with the conclusions of the opinion, holding that the plaintiffs were the owners of the patent in suit; that the processes employed by the defendant both before and after the filing of the bill of complaint, to and including January 7, 1917, embodied the invention of the patent and infringed Claims 1, 2, 3, 5, 6, 7, and 12 thereof, and Claims 9, 10, and 11, as limited by said disclaimer; and that the processes employed by the defendant from the 7th day of January, 1917, down to and through the time of the trial, embodied the invention of the patent and infringed Claims 1, 2, 3, and 12 thereof, and Claims 9, 10, and 11, as limited by the said disclaimer. The decree granted a permanent injunction against the further use of such process by defendant, and directed that an accounting be had for the assessment of damages accruing from such use. From that decree the defendant has appealed to this court.

Before Ross, Morrow, and Hunt, Circuit Judges.

Ross, Circuit Judge:

Notwithstanding the strenuous contentions on both sides of this litigation, the very elaborate preparations, and able arguments of many distinguished counsel, we can but regard the case as a very plain one.

To start with, the law is too well established to require discussion or the citation of authorities, that the patentee's rights under a patent are governed and limited by its valid claims—its specifications being referred to only as illustrative of the true meaning of the claims. It is equally well settled law that the mere result of an invention is not patentable; nor is froth, or scum, or pine-oil, or any other kind of oil, or oleic acid, patentable as such.

In their specifications the patentees of the patent in suit declare that their invention "relates to improvements in the concentration of ores, the object being to separate metalliferous matter, graphite, and the like, from gangue by means of oils, fatty acids, or other substances which have a preferential affinity for metalliferous matter over gangue;" but of the claims of their patent adjudged by the Court below to have been infringed by the appellant, not one specifies any particular kind of oil, although the fifth and sixth specify as one of their constituents "a small proportion of oleic acid (which is an acid existing in most fats in combination with glyceral), amounting to 0.02–0.5 per cent on the ore." And we do not understand it to be contended that the appellant uses any oleic acid in its process.

It is not denied that at the time of the invention in question the affinity of oil for the metalliferous portion of powdered ore, when mixed with water, was well known, as well as the further fact that the agitation of such a mixture with, as well as without, the addition of acid, would carry the metalliferous portions to the surface of the mixture and the gangue to the bottom; certainly those facts could not be successfully denied in view of the numerous references to the prior state of the art made in the opinion of this Court when this patent was last under consideration here and when the whole patent was by this court held void as lacking invention (214 Fed. 100).

That judgment was, it is true, reversed by the Supreme Court (242 U. S. 261). In doing so, however, the Supreme Court held invalid Claims 9, 10, and 11 of the patent, each of which claims was for "a small quantity of oil." So that it is plain the appellees are not entitled to be protected in the use of "a small quantity of oil" of any kind which, as is obvious, is a wholly indefinite quantity.

In holding claims No. 1, 2, 3, 5, 6, 7, and 12 of the patent valid to the extent that it did, the Supreme Court, after pointing out in its opinion that there were many investigators at work in the field to which the process in suit related when the patentees came into it, and that it was while engaged in study of prior kindred processes that their discovery was made, said:

"While the evidence in the case makes it clear that they discovered the final step which converted experiment into solution, 'turned failure into success,' (the former patents having used so much oil as to make its cost prohibitive—our observation) (The Barbed Wire Patent, 143 U. S. 275), yet the investigations preceding were so informing that this final step was not a long one and the patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as 'critical proportions,' 'amounting to a fraction of one per cent on the ore.'"

Amounting to *a* fraction of 1% on the ore is very far from saying amounting to *every* fraction of 1% on the ore; *a* fraction is one thing, *every* fraction is a very different thing. It is obvious, we think, that if the Supreme Court had meant to extend the scope of claims 1, 2, 3, 5, 6, 7, and 12 of the patent to *one per cent* of oil on the ore, as is here contended by the appellees, it would not have said anything about any *fraction* of 1% —certainly there would have been no necessity for doing so, and certainly the use of such specific language as it employed without a purpose cannot be justly imputed to that great tribunal.

That the "critical proportions" "amounting to a fraction of one per cent on the ore," so protected by the Supreme Court in its decision, does not include *every* fraction of 1% on the ore is, we think, very clearly shown by the same opinion where, after describing the prior state of the art, the Court said:

"Into this field of investigation at this state of its development came the patentees of the patent in suit. They were experienced metallurgists of London, of inventive genius and with financial resources, and they entered upon an investigation of the processes of oil concentration of ores which was continued through several years, and consisted of a very extended series of experiments in which the quantities of oil, of water, and of acid used and the extent and character of the agitation of the mass under treatment resorted to, were varied to an almost unparalleled extent as to each factor and the results were carefully tabulated and interpreted. It was while pursuing a comprehensive investigation of this character, having, as the evidence shows, the special purpose in mind at the time to trace the effect on the results of the process of a reduction to the vanishing point of the quantity of oil used, that the discovery embodied in the patent in suit was made. The experimenters were working on the Cattermole 'metal-sinking process' as a basis when it was discovered that the granulation on which the process depended practically ceased when the oleic acid (oil) was reduced to about five-tenths of one per cent 'on the ore'. It was observed, however, that, as the amount of oleic acid was further reduced and the granulation diminished, there was an increase in the amount of 'float froth', which collected on the surface of the mass and that the production of this froth reached its maximum when about one-tenth of one per cent or slightly less 'on the ore' of oleic acid was used. This froth, on collection, was found to consist of air bubbles modified by the presence of the minute amount of oil used and holding in mechanical suspension between 70% and 80% of the total mineral content of the mass treated. It was promptly recognized by the patentees that this froth was not due to the liberation of gas in the mass treated by the action of the dilute acid used, and its formation was at once attributed in large part to the presence of the air introduced into the mixture by the agitation which had been resorted to to mix the oil with the particles of crushed ore, which air, in bubbles, attached itself to the mineral particles, slightly coated as they were with what was necessarily an infinitesimal amount of oil, and floated them to the surface. The extent of the agitation of the mass had been increased as the experiments proceeded until the "series of Gabbett mixers, fitted with the usual baffles, were speeded at from 1,000 to 1,100 revolutions per minute." A careful consideration of the record in this case convinces us that the facts with respect to the process of the patent in suit are not over-stated by the plaintiffs' witness, Adolf Liebman, an expert of learning and experience, when he says in substance: 'The present invention differs essentially from all previous results. It is true that oil is one of the substances used but it is used in quantities much smaller than was ever heard of, and it produces a result never obtained, before. The minerals are obtained in a froth of a peculiar character, consisting of air bubbles which in their covering film have the minerals embedded in such manner that they form a complete surface all over the bubbles. A remarkable fact with regard to this froth is that, although the very slight and easily destructible air bubbles are cov-

ered with a heavy mineral, yet the froth is stable and utterly different from any froth known before, being so permanent in character that I have personally seen it stand for twenty-four hours without any change having taken place. The simplicity of the operation, as compared with the prior attempts, is startling. All that has been done is to add a minute quantity of oil to the pulp to which acid may or may not be added, agitate for from two and one-half to ten minutes, and then after a few seconds collect from the surface the froth, which will contain a large percentage of the minerals present in the ore.' It is not necessary for us to go into a detailed examination of the process in suit to distinguish it from the processes of the patents relied on as anticipations, convinced as we are that the small amount of oil used makes it clear that the lifting force which separates the metallic particles of the pulp from the other substances of it is not to be found principally in the buoyancy of the oil used, as was the case in prior processes, but that this force is to be found, chiefly, in the buoyancy of the air bubbles introduced into the mixture by an agitation greater than and different from that which had been resorted to before and that this advance on the prior art and the resulting froth concentrate so different from the product of other processes make of it a patentable discovery as new and original as it has proved useful and economical."

Nothing, it seems to us, can be clearer from the foregoing quotations from the opinion of the Supreme Court, than that it did not intend to extend the monopoly of the patent in suit to the use of 1% of oil on the ore; for it, in effect, thereby distinctly declares and adjudges that the discovery of the appellee "experimenters" only rose to the dignity of *invention* when they ascertained that the desired results could be and were obtained by the use of five-tenths (½) of 1% of oil on the ore, with still better results as the quantity was reduced, to the vanishing point at less than one-tenth of 1%. The quantity of oil that gave birth to the invention—five-tenths (½) of 1% on the ore (at which point no more granulation exists)—to the lesser and extreme limit of the minute quantity (less than one-tenth of 1%)—at which the desired result ceases, are the "critical proportions" "amounting to *a* (italic ours) fraction of one per cent on the ore," to which the appellees' patent is "confined" by the Supreme Court, as we understand its opinion.

And that is just what appears from the present record was the contention of the present appellees before the Supreme Court on the argument of their appeal from the judgment of this court holding that there was *no invention* in what they did. For it is undisputed that on the argument of that appeal this colloquy occurred between two of the Justices and two of the attorneys for the then appellants and the present appellees:

"Mr. Justice McReynolds: I would like to ask you when in this process of reducing oil your invention came into existence.

"Mr. Kenyon: At about one-half of one per cent of oil.

"Mr. Justice McReynolds: Before you got to the one-half of one per cent did you have any invention?

"Mr. Kenyon: We were passing from the region of Cattermole, which was a distinct—

"Mr. Justice McReynolds: I want to know when your invention came into existence.

"Mr. Kenyon: This invention was not reached, I should say from those figures, until about 0.5, that is one-half of one per cent of oil was reached.

"Mr. Justice McReynolds: At one per cent you had no invention?

"Mr. Kenyon: No.

"Mr. Justice McReynolds: At one-half of one per cent you did have invention?

"Mr. Kenyon: It began to come, remote, but it began to come. At 0.3 of one per cent the flow vastly increased. At 0.1 of one per cent the flow again vastly increased.

"Mr. Justice McReynolds: When this flow is more than one-half of one per cent of oil it does not infringe?

"Mr. Kenyon: It does not infringe.

"Mr. Justice Pitney: What have you to say in answer to what Mr. Scott said the other day, to the effect that 1.8%, or perhaps more, of oil would give the same result with increased agitation?

"Mr. Williams: Absolutely no.

"Mr. Kenyon: It would not.

"Mr. Justice Pitney: I understood him to say so yesterday, and I supposed that there was something in the record to justify it.

"Mr. Kenyon: Nothing; that will be a part of my argument."

Inasmuch as it appears without dispute that the appellant company has never used in its process any oil in quantity as small as one-half of 1%, it results from the views above expressed that the judgment must be reversed and the case remanded with directions to the Court below to dismiss the bill at the complainants' cost, without regard to the question raised respecting the sufficiency of the disclaimer filed by the appellate company or to its resultant effect.

HUNT, Judge, concurring:

I will briefly state the ground upon which my concurrence rests:

The Supreme Court in sustaining the claims carefully noted those which were limited to a fraction of 1%, and the decision explicitly confined the patent to the results obtained by the use of oil within the proportions often described in the testimony and in the claims.

Claims 1, 2, and 3 use the language, "amounting to a fraction of one per cent on the ore."

Claims 5, 6, and 7 express amounts, percentages on the ore.

Claim 12 uses the words of limitation, "amounting to a fraction of one per cent of oil on the ore."

Claims 9, 10, and 11 make no reference to a fraction of 1%, but do contain the words, " a small quantity of oil."

The essence of the invention was in the use of this extremely small fraction of 1%, and the Supreme Court, while sustaining the fraction of 1% claims, held invalid the small quantity claims, 9, 10, 11, because they were too broad. No monopoly could be given on the use of a

small quantity of oil, for that was old. It was new, however, to avoid the use of larger quantities. The patent must be confined to the use of critical proportions.

Now, keeping in mind that by the decision the Court has limited the invention to the critical proportions often described by the testimony and in the claims, we naturally ask: What are the critical proportions described in the specifications? Page 1, line 79, of the specification says: "To this is added a very small proportion of oleic acid (say, from 0.02 per cent to 0.5 per cent on the weight of the ore)"; and on line 96 we have: "The minimum amount of oleic acid which can be used to effect the flotation of the mineral in the form of froth may be under 0.1 per cent of the ore, but this proportion has been found suitable and economical." We thus have given to us one-half of 1% or less as the critical proportion described—preferably one-tenth of 1% is to be used.

We also ask: What is the evidence wherein there is often described the "critical proportion?" A summary of it is that it is very nearly one-tenth of 1% or two-tenths of 1% as may be required for particular ore. All through the evidence it appears that minute and critical amounts of oil are to be used as necessary to make the process successful. From one pound of oil to the ton of ore (five hundredths of one per cent) to four pounds per ton (two-tenths of one per cent) were the limits in practical work as stated by witnesses.

Again, when counsel had the colloquy (quoted in the opinion of Judge Ross) with the Supreme Court, the guiding thought evident in the mind of the inquiring Justices was to stamp precision upon the point when *invention in the process* began to appear. With apparent definite purpose of meeting the interrogatories plaintiff told the Court that 'invention' began to come when in the descending uses of percentages of oil as small a quantity as five-tenths of one per cent was used, and was first present when three and two-tenths of one per cent was used. Of course, a Court should cautiously consider a response often quickly made by counsel in answer to questions put from the bench lest an injustice may follow by attaching undue weight to an isolated argumentive answer. But in this matter we are earnestly trying to gather the scope and accurate meaning of the expressed thought of the Court. We may therefore refer to the fact that the exact position of the plaintiff as to the invention was called for not once but twice, not generally nor indirectly, but positively, simply, and unequivocally. Hence, in the controversy as to the true interpretation of the opinion the questions put and answers given may be fairly resorted to, not as conclusive at all but as aids toward a better understanding of the statement of the limitations of the claims of the patent and of the definition of the invention included in its language.

Nor do I think there is ground for saying that discrimination was had between known oils—whether vegetable, mineral, or animal. To oily liquids which have a "preferential affinity to metalliferous matter" must the plaintiffs be held, and in using kerosene or fuel-oil defendants are but employing oils which the patents authorize the use of; and when defendants use proportions beyond the critical ones of oil, not oleic acid, but other oils, they are not infringing. Oils doubtless vary in being adaptable for use. Some will probably secure more froth than others, and oil formulae may in their ingredients depend upon the particular ore to be treated and upon the economic relationship to the problem under solution. But the froth developed in using the minute quantities of oil is, I think, essentially of a character like the froth shown when different quantities of oil are used—the difference is largely by reason of a special quantity or kind of oil or the special extent of the agitation applied. The experiments made before us prove this.

In the Cattermole process the froth was held to be distinguishable from the froth produced in the patented process of the critical proportion of oil by the fact that certain remarkable and great results come from the use of the critical proportion which were not obtained when the quantity used in the Cattermole process was employed.

By using the critical proportion of oil, as defined, patentees get the maximum froth. They have discovered a process—not a froth—and the process is limited to the use of oil in the specified critical proportion.

The sequel of these views is that inasmuch as defendants keep out of the limits made for the plaintiff by the decision of the Supreme Court by using more than the critical proportion, they do not use plaintiff's process.

MORROW, Circuit Judge, concurring in part and dissenting in part:

I concur in the opinion of the majority of the Court that the decree should be reversed, but I do not concur in the direction that the bill be dismissed. I am of opinion that the use of an oil or oily liquid in defendants' separation process in a quantity not "amounting to more than a fraction of one per cent on the ore" is within the express terms of Claims 1, 2, 3, and 12 of plaintiffs' patent, and is an infringement of such patent. But I am of opinion that the use of oil or oily liquid in a quantity amounting to more than a fraction of 1% on the ore is not within the terms of Claims 1, 2, 3, and 12, and is therefore not an infringement upon plaintiffs' process and that a decree should be entered accordingly.

The direction of the Supreme Court in Minerals Separation, Ltd., v. Hyde, 242 U. S. 261, is that:

> "the patent must be confined to the results obtained by the use of oil within the proportions often described in the testimony and in the claims of the patent as critical proportions, amounting to a fraction of one per cent on the ore".

The term 'critical proportions' is not used in the claims of the patent, but such proportions were described in the testimony in the Hyde case as the application of a small but exact quantity of oil to different ores and always within the range of treatment of "a fraction of one per cent on the ore," never to the treatment of different ores within the range of "one-half of one per cent" except in the use of oleic acid and that upon certain ores such as Broken Hill ores. The application of the term 'critical proportions' in the use of oil on ores generally within a

range of "one half of one per cent" was discovered by counsel for appellant in this case and so far as appears from the record was revealed to the public for the first time in this Court.

The colloquy between Mr. Justice McReynolds and Mr. Kenyon, counsel for appellant in the Supreme Court in the Hyde case referred to by Judge Ross in his opinion related to the use of oleic acid on Broken Hill ores concerning which I do not understand that there is any controversy. I think the direction of the Supreme Court that

> "the patent must be confined to the results obtained by the use of oil within the proportions amounting to a fraction of one per cent on the ore"

means just what it says and that within such proportions the process described in the patent is held by the Supreme Court to be a valid discovery protected by the specifications and claims numbered 1, 2, 3, and 12. The Supreme Court does not say that the patent must be confined to the oleic acid claims (Claims 5, 6, and 7) nor does it say that the other claims of the patent must be confined to the use of oil in the fraction mentioned in those claims. Had the Supreme Court intended that the scope of the patent should be confined to the use of oil in the proportion not to exceed one half of 1% on the ore, it would certainly have said so in so many words and would not have left it to be inferred that the patent must be confined to results obtained by the use of oil in such proportions as are limited in Claims 5, 6, and 7. For what purpose does the Court hold Claims 1, 2, 3, and 12 valid? Manifestly because these claims provide for the use of oil in the proportions "amounting to a fraction of one per cent on the ore," that is to say, upon ores generally.

The specifications mentioned the fact that the ores were not all alike and that different ores may require the use of different proportions of oily material in order to secure the desired separation of metalliferous matter from the gangue by the production of a froth. The Supreme Court commenting upon this variation in the requirements of the process said:

> "Such variation of treatment must be within the scope of the claims, and the certainty which the law requires in patents is not greater than is reasonable, having regard to their subject matter. The composition of ores varies infinitely, each one presenting its special problem, and it is obviously impossible to specify in a patent the precise treatment which would be most successful and economical in each case. The process is one for dealing with a large class of substances and the range of treatment within the terms of the claims, while leaving something to the skill of persons applying the invention, is clearly sufficiently definite to guide those skilled in the art of its successful application, as the evidence abundantly shows."

The use of oleic acid on Broken Hill ore was the oil and the ore of the discovery, and the proportion of the oil used is described in Claims 5, 6, and 7, but how about the use of other oils on other than Broken Hill ores? The proportions required for oleic acid on Broken Hill ores had been determined by actual tests but other oils and other ores had not been fully tested and the application of the process might require a different proportion of oily material upon a different class of ores. To meet such a contingency, Claims 1, 2, 3, and 12 call for the use of an oil or oily liquid "amounting to the fraction of one per cent on the ore." Furthermore, in declaring Claims 9, 10, and 11 invalid, the Supreme Court clearly did so because such claims were not confined to the use of oil "amounting to a fraction of one per cent on the ore." The claim was for the use of "a small quantity of oil," which might be a quantity more than "a fraction of one per cent on the ore."

The validity of the other claims in controversy having been sustained upon their limitation of the use of oil within the proportion "amounting to a fraction of one per cent on the ore," it followed that Claims 9, 10, and 11 were held invalid because they were not so confined, and were therefore too broad. The disclaimer accordingly disclaims from Claims 9, 10, and 11 of the patent "any process of concentrating powdered ores excepting where the results obtained are the results obtained by the use of oil in a quantity amounting to a fraction of one per cent on the ore." Such language was strictly in accordance with the decision of the Supreme Court and, I think, a sufficient rejection of the excess from the invention claimed, leaving the patent in the form limited by the opinion of the Supreme Court.

With respect to the objection that the disclaimer was not filed in time, the mandate of the Supreme Court became effective January 13, 1917, decreeing the patent to be invalid as to Claims 9, 10, and 11, but valid as to the other claims in issue. On March 28, 1917, the plaintiffs filed their disclaimer, some time before the right to petition for a re-hearing in the Supreme Court had expired. Considering the importance of the procedure to be followed, the residence of the patentees in another country, and the consequent delay in communication, the date of filing was not unreasonably delayed.

PLATINUM PRODUCTION of the United States in 1917 was 605 oz. from placer mines. This is less than the sales in 1916 by 100 oz. Imports of crude platinum amounted to 31,921 oz., not counting the 21,000 oz. of Russian crude platinum that was received by the Government late in December last. During 1917, refiners made 33,000 oz. of platinum, 4800 oz. of paladium, 833 oz. of osmiridium, and 210 oz. of iridium, which can be called 'new metals.' Of this amount 7400 oz. probably originated from domestic materials. The saving of scrap platinum of all classes resulted in much larger recoveries of secondary platinum metals than in previous years, a total of 72,000 oz. being recovered, as compared with 48,000 oz. in 1916.

SPAIN has imposed restrictions upon the use of gasoline that are almost prohibitory. To supplement the diminished supply recourse is being had to the further development of alcohol for use in gasoline engines, including automobiles and trucks.

New Method of Determining Copper

By JAMES MOIR

†My object in devising this process was to develop a method of doing without the large quantities of the expensive potassium iodide required in the ordinary accurate process for copper. For example, if high accuracy is required in determining the true percentage of copper in a 'pure' copper, about 4 gm. of the metal must be taken, involving the use of about 30 gm. of KI and 16 gm. of crystallized thiosulphate.

If the equations on which the ordinary process depends be studied, it will be seen that the net result of the addition of iodide and thiosulphate to cupric acetate is to produce an insoluble cuprous salt along with a soluble tetrathionate.

(1) $CuAc_2^* + 2KI = CuI + 2KAc + \frac{1}{2}I_2$

(2) $\frac{1}{2}I_2 + Na_2S_2O_3 = NaI + \frac{1}{2}Na_2S_4O_6$

The net result is as if the equation were

(3) $CuAc_2 + KI + Na_2S_2O_3 = CuI + KAc + NaAc + \frac{1}{2}Na_2S_4O_6$

It therefore struck me that the simple direct reaction between cupric salts and sodium thiosulphate would be worth investigating. A number of double copper-sodium thiosulphates were described by German authors 30 or 40 years ago, but it is probable that the whole of this work is wrong, and that the substances obtained were really tetrathionates and not thiosulphates. When equimolecular solutions of copper acetate (or copper sulphate in the presence of acetic acid and sodium acetate) and sodium thiosulphate are mixed, the mixture is greenish yellow and, in my opinion, consists mainly of soluble cuprous tetrathionate, but also contains a proportion of unchanged cupric thiosulphate.

(4) $CuAc_2 + Na_2S_2O_3 = \dot{C}u\dot{S}_2O_3'' + 2NaAc$

(5) $2\dot{C}u\dot{S}_2O_3'' \leftrightarrows Cu_2S_4O_6''$

Equation (5), which is a balanced reaction between cupric thiosulphate and cuprous tetrathionate, is perhaps more intelligible with separate ions.

(6) $\ddot{C}u + \ddot{C}u + S_2O_3'' + S_2O_3'' = \dot{C}u + \dot{C}u + S_4O_6''$

The action being a balanced one is not suitable in itself for an analytical process; nevertheless it was obvious that the success of the old iodide method depended on the almost complete insolubility of the cuprous salt produced, otherwise the above balanced reaction would occur. This was confirmed on trying to replace iodide with bromide or chloride, the cuprous salts of which are fairly insoluble, when it was found that the reaction was incomplete. However, on trying sulphocyanide (thiocyanate) as a substitute for iodide success was obtained. The above balanced reaction then goes entirely in the direction of cuprous tetrathionate because the cuprous ion is removed as insoluble CuSCN as fast as it is formed, and on filtration a colorless solution containing only $Na_2S_4O_6$ and excess KSCN and $Na_2S_2O_3$ is obtained, in which, under special conditions, the latter can be estimated with iodine even in the presence of sulphocyanide.

The analytical process suggested is therefore as follows: Dissolve the weighed sample in HNO_3, and get it into the condition of very faintly acid cupric acetate, either by the old methods or by the quick process which I describe farther on. Add a slight excess of thiosulphate in known quantity (1 gm. copper requires 3.904 gm. crystallized thiosulphate, or about 158 cc. of *N*/10 thiosulphate) and immediately a sufficient excess of potassium sulpho-cyanide, equal to, say, $1\frac{3}{4}$ gm. per gramme of copper. The white precipitate of CuSCN is then to be filtered off, roughly washed, and rejected. Since it goes through every known variety of filter-paper, and since the solution cannot be heated (else the trace of acetic acid would act on the excess thiosulphate) it is necessary to add a quantity of pulped filter-paper before attempting to filter. This is made by boiling a loose-texture filter-paper in dilute caustic soda until disintegrated and neutralizing with acetic acid. On filtering, about 5 cc. will come through turbid before the pulp chokes the pores of the paper, after which a clear filtrate is obtained. As there is very little excess thiosulphate in this filtrate, any elaborate washing of the CuSCN precipitate is a waste of time.

To finish the analysis, the filtrate is first diluted to about a litre and then treated with 5 to 10 cc. concentrated pure H_2SO_4 (do not use HCl which, in a country with bright sunlight, always contains free chlorine) and a little starch-solution and titrated back with *N*/10 iodine, only a small quantity being required if the directions regarding thiosulphate have been followed. The calculation is merely:

$$\frac{\text{cc. true N/10 thiosulphate at beginning} - \text{cc. N/10 iodine}}{157.3} = \text{Cu}$$

The copper present is given in grammes by this equation, assuming 63.6 for its atomic weight. The filtrate must not be titrated with iodine without the high dilution and the mineral acid, otherwise iodine is absorbed by the excess KSCN present. Iodine does not apparently attack dilute HSCN.

If the approximate percentage of copper in the sample is totally unknown, the experiment must be done twice, first on a small sample of 0.1 gm., using 16 cc. of *N*/10 thiosulphate; and, second, repeating this, using thiosulphate equal to the thiosulphate minus iodine of the

†Abstract from Journal of C. M. M. Society of South Africa, November 1917.

[*The author used the symbol A for the acetic acid radical, which we have changed to Ac.—Editor.]

first experiment. Thus if experiment 1 used 2.5 cc. iodine at the end, the correct thiosulphate for experiment 2 is at the rate of 135 cc. per gramme of material. This means that the method gives high results for copper (102 to 105% of the truth) when a large excess of thiosulphate has been used, but is sharply accurate when the thiosulphate is just in excess.

If extreme accuracy is required, 2 to 3 gm. of the sample must be taken, in which case it is better to weigh out the thiosulphate required. This is because 400 cc. of thiosulphate solution would have to be taken, and the factor of any thiosulphate solution is not generally known within 1 part in 500, besides which it varies with temperature. The following is a description of some of my results with the method:

1. Analysis of $CuSO_4 \cdot 5H_2O$. A sample of 0.2500 gm. in water and treated with sodium acetate and two drops HAc, then with 12.19 cc. $N/10$ thiosulphate of factor $0.985 = 12.01$ cc. true $N/10$ thiosulphate. At the end the diluted acid filtrate required 1.99 cc. $N/10$ iodine: the quantity of copper is

$$\frac{12.01 - 1.99}{157.3} = 0.0637 \text{ gm. (theoretical } 0.0636).$$

2. Pure copper (99.6% by iodide method). A sample of 0.1280 gm. dissolved: preliminary trial with 25 cc. thiosulphate used 4.4 iodine (giving Cu = 102%!). Second trial with 20.6 thiosulphate (corrected) used 0.54 iodine

$$\text{Cu} = \frac{20.06 \times 100}{157.3 \times 0.128} = 99.7\%.$$

Third trial with 20.5 thiosulphate used 0.40 iodine: Cu = 99.85. These discrepancies are due solely to the smallness of the sample taken, when one drop of reagent makes a difference of $\frac{1}{4}$% in the result for copper. If 1 gm. sample had been taken, an accuracy of 0.03% per drop could have been expected.

3. Electrolytic copper (over 99.9%). 0.1803 gm. dissolved: 29.3 cc. thiosulphate and 0.7 iodine used in first trial (Cu = 100.7%): In second trial 28.60 thiosulphate (corrected) and 0.25 iodine: 28.35 difference or Cu = 99.9%.

4. Copper-nickel-tin-lead alloy. After a preliminary trial, 24.66 cc. (corrected) thiosulphate used for 0.2315 sample: iodine used 0.78. Cu = 65.6%. In this case the foreign metals were not separated and did not interfere, as analysis of this sample by standard methods gave Cu = 65.8%.

Owing to the nature of my process scarcely any of the common metals (except iron) interferes. Only such metals could interfere as are capable of being reduced from their *ic* condition to their *ous* condition by dilute thiosulphate, the *ous* condition being then not oxidizable by iodine. So far as I can see, iron is the only metal that fulfils such conditions.

The quick process mentioned for getting the dissolved metal or ore into a condition for determining the copper depends on the little-appreciated fact that nitric acid is not an oxidizing-agent if nitrous acid is removed from it. According to the ionic theory, dilute pure nitric acid consists only of the ions H′ and NO_3', the latter of which has no tendency to part with its oxygen unless a strong reducing-agent is added.

The metal or ore is dissolved in a covered vessel with concentrated HNO_3; the solution is agitated for a minute or two to get rid of as much dissolved NO_2 as possible, diluted to 20 cc. and treated with $\frac{1}{2}$ gm. of urea (carbamide). After the effervescence has stopped the mixture is diluted to 50 cc. and boiled for 15 seconds. Thereupon caustic soda is added to near neutrality, followed by 2 or 3 gm. of solid sodium acetate. The analysis can then be proceeded with.

The destruction of the nitrous acid is explained by the equation:

$$CH_4ON_2 \text{ (urea)} + 2HNO_2 = CO_2 + 2N_2 + 3H_2O$$

MOLYBDENUM ores are usually purchased on the basis of the molybdenum sulphide contained. Wulfenite is usually bought on the basis of its metallic content, or on the molybdic oxide, MoO_2, contained. Ferro-molybdenum is usually offered on the basis of its metallic content. In the United States and Canada, payments are calculated on the short ton of 2000 lb., and the quotations for MoS_2 are based on the unit of 20 lb. In Great Britain, and many parts of the British Empire, except Canada, the long ton of 2240 lb. is used, and the unit quotation is based on a quantity of 22.4 lb. The schedules on which payments are made are somewhat detailed. Buyers of molybdenite ores that contain from 0.5 to 3.0% molybdenite, have paid for 70 to 92% of the sulphide contained, after deducting a suitable treatment-charge. The middling product and concentrate containing from 3 to 85% molybdenite, and crude ore containing from 2 to 80% molybdenite, are purchased, the price paid for the lowest grade being 20 to 35% less than for the highest grade. Penalties are usually imposed for bismuth and copper. Ferro-alloy makers will purchase ore or concentrate which contains 65% molybdenite, provided the iron does not exceed 10%.

NEW EXPORT DUTIES on minerals from Peru are as follows: On metallic silver in any form, $1.50 U. S. per kilogramme; and for sulphides or precipitates, one-fourth that of the metal. On copper, $1.25 per short ton, plus 10% of the excess of the current price at New York, over the minimum valuation of 13 cents per pound. Gold in copper and smelter products in excess of 6 grammes per ton is increased from $9.60 to $48 per kilogramme, with a refund if an equivalent amount is imported. Vanadium ores and concentrates are dutiable at $4.80 per metric ton, when the vanadic-acid content is from 18 to 20%, with an increase of $2.40 per ton for each additional 5 units of contents above 20%. For tungsten the rate is $4.80 per metric ton when the price in New York is not less than $20 per unit. The excess value of the exported product is subject to a tax of 10%, based upon an assumed content of 50% of tungsten. Molybdenum ores and concentrates are dutiable at $9.60 per ton without qualification or surcharge. Formerly the duty on all of these ores and concentrates was fixed at $4.80 per ton without regard to value.

Zinc From Broken Hill

By courtesy of Mr. G. D. Delprat, manager for the Broken Hill Proprietary Co., at Broken Hill, New South Wales, we are enabled to publish a photograph of the first 50 tons of zinc concentrate produced at Broken Hill by means of flotation without the use of oil by the Delprat process in May 1903. This same process is still in use; it has helped to produce 836,343 tons of zinc concentrate up to March 6, 1918. The photograph shows a



THE FIRST SHIPMENT OF ZINC CONCENTRATE PRODUCED BY OIL-LESS FLOTATION AT BROKEN HILL

Left to right: E. T. Henderson, L. Bradford, J. A. Lindsay, G. D. Delprat, R. V. Spier, M. B. Petch, E. J. Horwood, C. G. Hylton.

group of notable men, most of whom have made a name for themselves as inventors and patentees of various modifications of the flotation process. In the Delprat process a hot solution of acid salt-cake is added to the crushed ore as it is fed upon a pan having a sloping bottom heated by a Bunsen burner, the sulphides being raised to the surface by the bubbles of carbon-dioxide gas and air generated by chemical action and heat. We have asked Mr. Delprat to send us a description of his process as improved by experience in the mill.

MANGANESE, even in minute quantities in solution, may be detected as follows, according to H. S. Paine, following V. Macri (Boll. Chim. Farm. 56, p. 377, 1917). Render the solution slightly alkaline, and shake with several drops of an alkali oxalate solution, and finally with a few drops of AcOH. The liquid assumes a distinct and persistent rose color. The reaction is more sensitive if the alkaline solution is boiled and allowed to cool before adding the oxalate and AcOH. The reaction does not occur if a mineral acid is used or if $(NH_4)_2SO_4$, for example, is substituted for $(NH_4)_2C_2O_4$. The presence of the oxalate is indispensable to secure a distinct reaction. Salts of other metals do not interfere, except that Cu, Fe, Ni, Co, Pt, Au, and Cr, which give colored solutions, mask the reaction if present in considerable amount. It is desirable, nevertheless, to separate the other metals. A pronounced color was obtained with one drop of a 0.1% solution without previous boiling. The reaction may be facilitated by adding one to two drops of H_2O_2 before making the solution alkaline.

During 1917 the low-grade mill of the Nipissing Mining Co., at Cobalt, Ontario, treated 73,015 tons of ore assaying 31.13 oz. of silver per ton. In extracting 1,932,831 oz., equal to 80.64%, the cyanide plant used the following supplies:

	Total lb.	Cost per lb.	Total cost	Lb. per ton	Cost per ton
Sodium cyanide	338,024	$0.3270	$108,406	4.6290	$1.4847
Caustic soda	61,867	0.0390	2,423	0.8470	0.0332
Lime	367,125	0.0046	1,697	5.0290	0.0232
Aluminum ingots	10,162	0.5540	5,637	0.0139	0.0772
Pebbles	452,007	0.0108	4,905	6.1900	0.0672
Steel balls	20,000	0.0489	978	0.0274	0.0134
Borax	9,212	0.1062	978	0.0126	0.0134
Sodium sulphide	105,345	0.0348	3,671	1.4560	0.0503
Coal	2,379,240	0.0039	9,222	32.5850	0.1263
Coke	38,450	0.0080	309	0.5260	0.0042
Fuel-oil, gallons	24,838	0.1150	2,882	0.3400	0.0395
Power	.....	.....	55,166	.....	0.7555
			$196,274		$2.6881

Manganese Requirements

The needs of the steel industry of the United States are about 800,000 tons of manganese per year, corresponding to 310,000 tons of ferro-manganese. In 1917 our imports of manganese ore were 629,972 tons, the remainder being supplied chiefly by our own mines, working at full capacity. Our 85% of the 1917 imports probably came from Brazil. The output of standard ferro-manganese in this country last year exceeded all records, being 257,834 gross tons, or nearly 50,000 tons in excess of the previous high record of 208,389 tons in 1916. The following table, based on the monthly blast-furnace reports of 'The Iron Age,' gives the output of ferro-manganese and spiegeleisen in the United States in the last six years, stated in gross tons:

	Ferro-manganese	Spiegel-eisen	Total	Average per month
1917	257,842	188,852	446,686	37,222
1916	208,389	197,518	405,807	33,817
1915	146,542	93,282	239,824	19,985
1914	106,083	100,365	206,448	17,204
1913	119,495	126,081	245,576	20,464
1912	125,378	119,506	244,884	20,407

While the expansion in 1917 was not as great as that in 1916, it was large. The shrinking in the spiegeleisen output was unexpected, and while the decline is not large, the total is twice that of 1915. Details of the production, imports and exports of ferro-manganese for 1917 in gross tons were:

	Output	Imports	Exports
Total	257,853	45,381	5,468
Monthly average, 1917....	21,486	3,703	....
Monthly average, 1916....	18,461	7,577	....
Monthly average, 1915....	12,021	4,605	....
Monthly average, 1913....	9,958	10,672	....

These figures show how the domestic output has been steadily climbing. In the last half of 1917 the monthly output was 23,000 tons, or almost double that for 1915, and over twice that of 1912, which was the pre-War record. The significant fact is the dwindling of the imports from England. In 1917 they were at the rate of 3703 tons per month, declining in the last half to 2464 tons per month. Soon after the entrance of the United States into the War, it was officially estimated that the steel industry of the country needed 28,000 tons per month of ferro-manganese. The average available supply for 1917 was 25,032 tons per month.

The increased demand for manganiferous steel products, coupled with the cutting off of important sources of supply, has materially affected prices. From 1900 to 1914, 49% ore sold for from 23 to 30c. per unit. In 1916 it rose to 45 to 65c.; in 1917, it reached $1, and in some cases has gone as high as $1.20 to $1.50 per unit. Stated otherwise, the prices paid for the ordinary run of ores varied from about $8 to $14 per long ton before the War, while in recent months similar ores have brought from $40 to $75. Ferro-manganese, which before the War sold at about $40 per ton, has recently been quoted at about $175. Spiegel, which averaged about $25 in 1914, sold at about $65 last year. The fundamental war problem involving manganese is how to satisfy the greatly increased demand. The United States can get practically no manganese ore from contiguous countries. The ore must be brought chiefly from distant lands by marine transportation, at a time when all available ship-tonnage is of the utmost importance for the transportation of men, munitions, and food to Europe. A ship can make several round trips to Europe in the time it can make one round trip for a cargo of ore to Brazil or India. The fleet of 20 or 30 ships that had been engaged in this trade during the last year was an object of great concern to the Government authorities and to the Shipping Board.

The main domestic sources of supply have been the nodular and pocket ores of Virginia, Georgia, and Arkansas, and the lenses and vein deposits of California. In none of these places are there large bodies of high-grade ore that can be rapidly worked. While no close estimate can be made, it seems likely that, with the probable increased demand for 1918, with steel practice remaining the same, even under the stimulus of high prices and favorable governmental action, the production of high-grade ore could not be made to exceed 20% of the manganese content needed for ferro-manganese.

Low-grade ores, suitable for the production of the low-grade alloys, are more widely spread, and in larger masses. The most important manganiferous iron-ore deposits are in the Lake Superior iron region. Harder and Johnston have recently described important areas in the Cuyuna district, Minnesota, where, associated with ferruginous cherts and shales, large bodies of iron ore frequently carry manganese in quantities varying from 1 to 35%. Several million tons appear to be available. The Appalachian belt, Arkansas, and California, and adjoining States, also carry lower-grade ores, associated with those of higher grade. Except in California, these are usually manganiferous iron ores. In California the iron content is usually low, and silica high.

Since the beginning of the War, a start has been made in utilizing the ores in Montana, Colorado, Utah, Nevada, Arizona, and New Mexico. The manganese varies from a trace up to 30 or 40%, and there is apparently a large supply that would average 10 to 15%. Another source of manganese is the residuum from the working of the manganese-zinc ores of New Jersey. In 1915 this amounted to 152,318 tons, averaging 14% manganese.

Another line of attack is being directed toward a change in metallurgical practice. Experiments are being tried in some of the steel plants in the substitution of spiegel for ferro-manganese in the open-hearth process. A careful study of the field indicates that the steel industry can really get along with less manganese, or can use alloys in which other more available material is in part substituted for it. Such changes will lessen the demand for ore an equal amount, but as an essential element of the War there will be a continuous demand. In so far as such changes or substitutions are made the demand for high-grade ore or for manganese itself will be lessened.



NEW YORK

American Institute of Mining Engineers: Its Title.

The proposal to change the name of the American Institute of Mining Engineers to the American Institute of Mining and Metallurgy has aroused considerable interest. The current bulletin contains much information in this connection. It is explained that the proposal was previously abandoned, without the taking of a vote, in 1912, in order to permit the paying of attention to matters of more importance. The need for including reference to metallurgy in the designation of the Society is emphasized by the fact that more than two-thirds of all the papers found in the Transactions during the past three years referred to metallurgical practice and advance, which is sufficient evidence of the importance of this phase of metal production. It also has been pointed out that a large number of metallurgists, many of whom are recognized authorities, are unwilling to join a society that would confer upon them the title of 'mining engineer,' realizing that this would be a misnomer, besides being of no professional value to them. Many of these, as the secretary of the Institute states, have never seen a mine, and the majority have little or no interest in mining engineering, in itself considered.

During a trip by officers of the Institute in March and April through some of the Western States the question of changing the name of the Institute was raised and comment invited. The Chicago section appeared to be unanimously in favor of the change. The members of the Boston section either withheld comment or favored the scheme. At Salt Lake City there was a majority in favor of the new name. At Anaconda there was unanimous approval. The Columbia section made no objection. At Puget Sound the idea was favorably received and without opposition. The St. Louis section was unanimously in favor of the alteration.

Although the results recorded do not represent the opinions of all the members connected with the various sections referred to, the conclusion may be reached that, as the straw-vote shows, a large number of members of the Institute would welcome a change which would tend to enhance their professional status as metallurgists; and that the great majority of members would favor the scheme as a more satisfactory method of designating the society. In view of the apparent unanimity of opinion elsewhere it is strange to note that the Colorado section was apparently opposed to the change for several reasons. In the first place, it was stated that the old name had been in satisfactory use for 47 years, and that this was sufficient cause for its retention. How the sponsors of this argument can ignore the immense progress in metallurgical advance during this period, the increasing interest being taken in metallurgical practice, and the far-reaching importance of metallurgical research, is a matter for surprise. The second argument against the change was that the word 'metallurgy' is not understood by the public, which is unable even to spell it. Assuming that the general educational standard is as low as suggested, which is open to question, the fact remains that the public has no interest or influence in the choosing of a suitable or fitting designation for a professional society. The members themselves are the best judges. If one of the general public wished expert advice on some metallurgical process he would be little likely to seek a consultant from among the members of a society of 'mining engineers.' The arguments of the Colorado section can carry no weight; they are altogether unconvincing. The proposed change would not affect the status of the mining engineer in any way; it would merely accord a just recognition to the metallurgist, who has done so much to make the Institute a success, and whose endeavors have contributed to the present magnitude of the metal-mining industry. The final argument against the change, made at the Colorado meeting, was that metallurgists are no more entitled to be represented in the Institute's name than geologists, chemists, or assayers. The objection indicates a misapprehension of the facts. The A. I. M. E. is not intended as a suitable professional society to include persons interested only in pure chemistry or geology. If his specialty is metallurgical chemistry he will doubtless voice no objection to being a member of an institute of mining and metallurgy. A copper metallurgist who disclaimed a knowledge of physical chemistry would be an anomaly. A gold metallurgist who knew nothing about technical chemistry would be lacking in the fundamentals of his art. Metallurgical chemists—and these are the only types of chemists the Institute includes—will be content with the new name. Assaying is also a phase of metallurgical work, and few assayers would object to being classed under 'metallurgists'; but, in company with the metallurgical chemists, they realize that the designation 'mining engineer' does not apply to them and, what is more, is not desired. The importance of mining geology is recognized, but there are few geologists who would disclaim the title 'mining engineer,' or would suggest that they represent a fraction of the Institute members claiming prior right to a specific designation in the title. Statistics show the predominant interest to be, respectively, mining and metallurgy; and a society named as now proposed may well include both mining geologists and metallurgical chemists.

The objections from Colorado savor of a desire to revive the exploded fallacy that the profession consists of mining engineers only. This contention pretends to ignore the fact that the increase in metal production during the past 30 years owes much to the skill and ability of specialists who are not mining engineers. Metallurgic progress since 1887 has marked an advance unparalleled in any other similar period in the world's history; and metallurgists claim recognition of the fact. The change in the title of the Institute will be welcomed by the large number of specialists who have added their writings to the Transactions. It will not be deemed an intrusion by those members who are more particularly interested in mining rather than metallurgy and who will be generous enough to agree with the late president of the Institution of Mining and Metallurgy, of London, when he said that "the fact was often overlooked that the metallurgist was a specialist whom they, as mining engineers, gladly recognized as being no less important to the success of mining enterprise than themselves."

Of building stones quarried in New York State, sandstone leads in value, followed by granite and marble.

CRIPPLE CREEK, COLORADO

Drainage-Tunnel.—Power for the Golden Cycle.—Leasing-Profits.

The Roosevelt drainage-tunnel was advanced 100 ft. during April; the Cresson drift from the tunnel-level, on the Funeral dike, 212 ft.; and the Portland drift toward the main or No. 2 shaft 198 ft.; a total of 510 ft. of work at the tunnel-level. The flow from the portal has fallen to 3055 gal. per minute.

The State Untility Commission having rejected the petition of the Golden Cycle company for a restoration of the original rate charged by the Colorado Springs Light, Heat & Power Co., the Golden Cycle has decided to construct an electric power-plant costing $200,000. The site has been selected near the company's Pikeview coal mine near Colorado Springs. The plant will furnish power and light to the mill and to the mines of the Pikes Peak Fuel Co., controlled by the Golden Cycle at Pikeview.

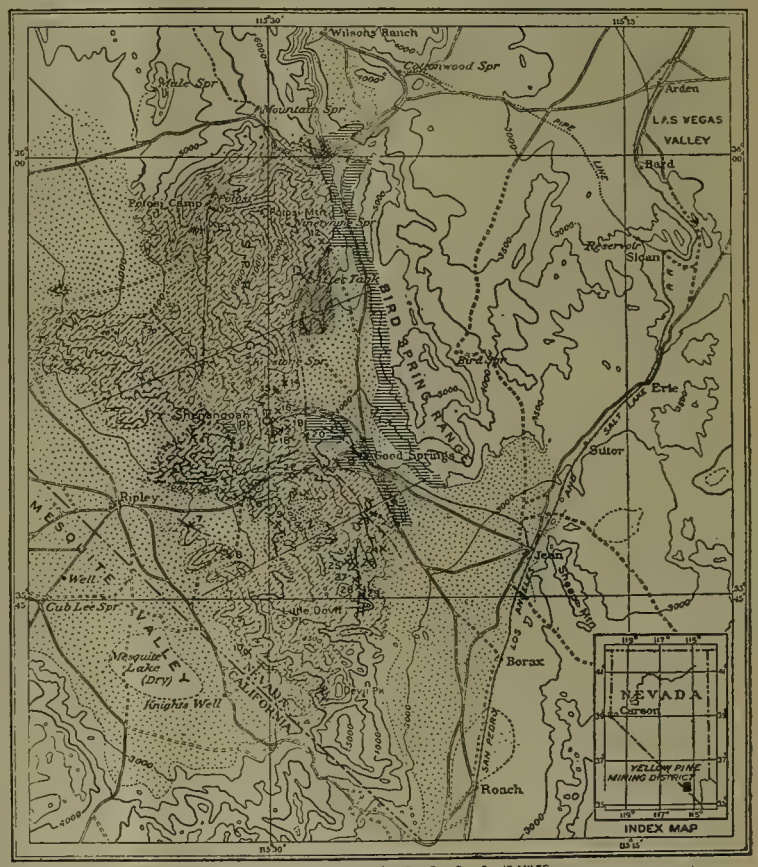
Net profits from the Hayes lease on No. 11 level of the Vindicator Consolidated for April exceeded $30,000. This is remarkable, few, if any, leases of the district have earned such profits in so short a time. The ore-shoot being worked is on the middle vein of the Vindicator system. The ore as broken is from 12 to 30 ft. wide, and that shipped was taken out by driving only. No stoping has been done. The drift on the ore is 70 ft. long, and coarse rock has averaged close to 2 oz. gold per ton, and screenings over 5 oz. The last car of screenings settled for 5.24 oz. The lease is worked on the split-check system, the owning company receiving one-half, or $15,000; A. I. Hayes of Victor, Peter Cartee of Goldfield (Colorado), and W. M. Craig of Cripple Creek dividing the remainder according to their several interests. With stoping started the output and profits are expected to increase.

The United Gold Mines Co. in April shipped 3000 tons of ore worth $50,000 from its Bonanza, Trail, Wild Horse, and W. P. H. mines.

GOODSPRINGS, NEVADA

General Description of the District.

Yellow Pine mining district, Clark county, is described by Fred A. Hale Jr. in Bulletin 134 (February 1918), of the A. I. M. E. The region has an area of 400 square miles. Principal shipping point is Jean on the Salt Lake Route. Goodsprings is the centre. Water is not abundant, but wells have been opened at Goodsprings, Mesquite valley, and springs on Mt. Olcott. Climate is equable. Mormons discovered lead ore in 1852. Gold was found in the early 'nineties. Zinc was recognized in 1906, and the opening of the Salt Lake Route added impetus to production. The lead-zinc oxidized ores were complex, and smelter returns were disappointing. By 1910 the Yellow Pine Mining Co. had evolved a separating process, and erected a 100-ton mill that has worked since. In 1911 this company constructed a narrow-gauge line, which improved transportation facilities in the district. Other mills have been erected, and production steadily increased. Output of the district was 76,382,543 lb. zinc, 26,692,680 lb. lead, 1,327,390 lb. copper, 739,980 oz. silver, and $206,684 gold to the end of 1915, valued at $7,847,332; and to end of 1917 approximately $12,000,000. Principal ore deposits may be divided into two general classes, namely: (1) oxidized lead-zinc, and (2) copper-gold; some of the latter carrying platinum metals. Lead-zinc deposits have yielded most of the ore. Orebodies are essentially of the replacement type, and are apparently confined to one limestone stratum, although frequent step-faulting, with considerable throw, gives the appearance of separate orebodies. In the Yellow Pine mine ore at depth (900 ft.) is as thoroughly oxidized as close to surface, no sulphide of zinc having been found, and no increase in the amount of lead sulphide. Down to 950 ft. there is no water. The copper-gold deposits apparently have no stratigraphic relation to the lead-zinc deposits, although they are determined by presence of fracture-zones. Dry concentration is satisfactory for the 10% lead and 30% zinc ores, but treatment of low-grade ore has not been solved.



1. Potosi
2. Green Monster
3. Keystone
4. Aura Amigo
5. Whale
6. Bill Nye
7. Hoodoo
8. Springer and Tiffen
9. Hoosier
10. Milford
11. Addison
12. Ninety-nine
13. Contact
14. Ninety-three group
15. Red Cloud
16. Prairie Flower
17. Yellow Pine
18. Alice
19. Porphyry Canyon
20. Lavinia
21. Columbia
22. Frederickson
23. Monarch
24. Lincoln
25. Porter
26. Monte Cristo
27. Accident
28. Bonanza
29. Anchor

MAP OF YELLOW PINE DISTRICT, NEVADA (AFTER J. J. HILL, U. S. G. S.)



ARIZONA

Bisbee.—The Denn-Arizona Copper Co. in 1917 produced 98,932 lb. copper, 858 oz. silver, and 50 oz. gold from 1477 tons of ore. This realized $17,539 at the smelter. New development cost $179,648 net, that is, from May 1 to December 31, 1917, the period of operation. To raise money the capital was increased from 350,000 to 500,000 shares of $10 each, 50,000 being offered to holders of outstanding shares at the ratio of 1/7 of one new share for 1 of outstanding shares, making 49,968 available. Of these, 47,737 were taken up, amounting to $477,370. All indebtedness has been paid, leaving $191,026 on hand to meet current accounts. By June 1918 it is hoped that shipments will pay expenses. Resumption of work late in April 1917 resulted in re-timbering the shaft, re-building the head-frame, repairing the 1000, 1100, 1250, and 1350-ft. stations, cutting a new station on south side of 1250-ft. level, also at 1450-ft., and doing 3392 ft. of development from 1100 to 1450 ft. depth. Pay-ore (oxide) in small quantities was exposed on the four levels. New equipment and construction cost $38,973, and resumption repairs $81,057. L. C. Shttuck is general manager.

Shattuck-Arizona company in the first quarter of 1918 made a profit of $185,518, compared with $696,099 in the same period of 1917. Copper ore smelted amounted to 24,272 tons, and lead ore 501 tons. These yielded 2,717,075 lb. copper, 217,643 lb. lead, 267 oz. gold, and 27,618 oz. silver. New development covered 4263 ft. Between the 800 and 900-ft. level a good body of 4½% pyritic copper ore was exposed. Construction of the lead concentrator is well advanced.

Chloride.—The Tuckahoe mine has been equipped with electric pumps and will be unwatered at once.

The Bella Union last week shipped the first bullion that has been sent out from the Chloride district for a long time.

The 1700-ft. tunnel on the 400-ft. level of the Copper Age is nearing completion. This property is said to have 250,000 tons of ore blocked out. The mill is expected to be started by the end of May.

This important mining district was described briefly by Rush T. Sill of Los Angeles in February 'Mining and Oil Bulletin.' Chloride is 26 miles north of Kingman on the Santa Fe railroad, and is on the western border of the Cerbat mountains, which are high and rugged. The district covers an irregular area about 6 miles diameter. Veins occur as two systems, one striking north 10 to 30° west, the other more or less associated with younger intrusions of granite-porphyry. In some, the ore is associated with dikes of andesite and rhyolite. Outcrops are generally prominent, consisting of reddish-brown quartz and manganese. The north-south veins are the most important. They carry gold, silver, lead, zinc, iron, and a little copper, lead and zinc predominating. At the present time sulphide ores are utilized principally, but the rich secondary ores, containing hornsilver, native silver, and in some places ruby silver, furnished the bulk of the production in early days. The number of deposits is large, and owing to the fact that work was generally abandoned when the lean primary ores were encountered, the area contains a large number of small mines that may be capable of further production.

Principal mines of the district are on this north-south system, the Tennessee, Schuylkill, Elkhart, Payroll, Emerson, Minnesota-Conner, Hidden Treasure, Golconda, and others. Most important of these is the Tennessee, which has been worked for almost 25 years, and has a production estimated at $20,000,000. The Schuylkill mine, now being worked by Burke, Garbutt, and others, has been developed to 800 ft. Good bodies of ore have been developed. Since the owners of the Tennessee mine refused to extend the time for payments to the U. S. Smelting, Refining & Mining Co., the Schuylkill company has made arrangements to take over the Tennessee and its work in conjunction with the Schuylkill, developing the latter from the 1400-ft. level of the former. The Tennessee was being worked at a depth of 1600 ft. Orebodies are large; in some places 22 ft. of solid galena and sphalerite was mined.

Elkhart mine, adjoining the Schuylkill mine on the north, is a producer of early days. The mine has produced from the surface to the 500-ft. level. Ore is similar to that of the Tennessee, and there is every reason to believe, from the size of the orebodies on the 500-ft. level, that ore will be found at a much greater depth.

Minnesota-Conner is another famous producer of high-grade ores, which was operated some years ago. It has been developed to 700 ft., and is equipped with an extensive milling plant.

Golconda has been developed to 1100 ft., and has produced $10,000,000. It was equipped with a modern mill, which burned in the latter part of 1917, causing a shutdown.

The east-west veins have been developed most extensively on the Flat to the west of Chloride. This is open country on the edge of the Sacramento valley. The principal mines developed on the east-west silver-bearing veins are the Towne, Merrimac, Diana, Rattlesnake, Tuckahoe, Midnight, and a number of fair prospects upon which there has been a small amount of development. The first named yielded $1,000,000 between 1882 and 1906. It might be said that little attention has been given these east-west veins.

The Chloride district has produced many millions in gold, silver, lead, and zinc ores. With the high price of lead and zinc that have prevailed for the last two or three years, the camp has been active; but with the drop in prices, many of the smaller mines have had to suspend operations. There is a possibility, however, that with the high price of silver, some of the mines on the Flat will be equipped and reopened, which will add to the life and production of the district.

Humboldt.—On June 1 Consolidated Arizona Smelting Co. pays 15c. per share.

Jerome.—At present there are three producing and twelve developing companies in this district, employing 3500 men. The monthly output is over 13,000,000 lb. of copper.

United Verde Extension's new smelter may be blown-in about the middle of June. The 425-ft. stack is practically finished.

Verde Combination has done several thousand feet of work on its 700-ft. level, where a leached zone was opened. Sinking to 1000 ft. is in progress.

Calumet & Jerome is driving a long cross-cut south-west

from its 600-ft. shaft to explore a formation exposed in an adit driven above the shaft.

The Shea mine is considered one of the best prospects in the district. At a depth of 350 ft. in the incline shaft a vein is being followed. Car samples assay 1.2% copper, 28 oz. silver, and $6 gold per ton.

The Grand Island company is drilling to 800 ft. to cut a vein exposed by the 208-ft. shaft.

In the Pittsburgh-Jerome some good ground has been opened on the 500-ft. level. Five drifts are being driven. About 35 men are employed.

Jerome Verde has resumed work at its Maintop claim, which yielded 1600 tons of 9% ore last year. The work now being done is on the 1400-ft. level from the United Verde Extension, 200 ft. below the point from which the ore was taken. A raise will be run to connect these two levels. The company is also developing from the 1405-ft. level of the Columbia shaft, both by diamond-drill and drifts.

Results at the Dorothy May shaft and Gorge tunnel of the Green Monster are encouraging, and it has been decided to sink 300 ft. deeper.

Miami.—Liberty Bond subscriptions taken by this centre were as follows:

Inspiration Consolidated Copper Co	$1,000,000
Miami Copper Co	50,000
Employees of—	
Inspiration	119,750
Miami	97,000
International smelter	32,000
Total for district	$1,299,250

ARKANSAS

Fort Smith.—The Fort Smith Spelter Co. has closed its smelter and rolling-mill indefinitely. This is considered peculiar, as there is said to be a big demand for sheet-zinc.

CALIFORNIA

The California State Mining Bureau, at the Ferry building, San Francisco, has prepared a topographical and geological map of Inyo county. It shows in detail the situation of ore deposits, geological structure of the region, towns, post-offices, springs, wells, railroads, wagon-roads, and trails. This area is one of the most interesting geographically, as well as from a mining standpoint, of any similar area in the West. The county contains 10,019 square miles, with an estimated population of 7500—less than one inhabitant to a square mile. It is noted because of the fact that within its borders are both the highest and the lowest points in the United States; the former, Mt. Whitney, has an elevation of 14,501 ft., and almost within sight of this mountain is a point in Death Valley which is 280 ft. below sea-level. This sparsely settled and rugged district produced last year minerals valued at approximately $5,000,000. A large proportion of the borax production of the United States comes from the county. Its mountains produce gold, silver, copper, lead, zinc, and other metals; and from its old lake-beds are derived soda, salt, nitre, and similar substances. The map mentioned has been lithographed in 17 colors, and is offered for sale at 60c., which merely covers the cost of printing. A report describing in detail the mineral resources of this county has also been recently published by the Bureau, and both map and report may be obtained for $1.25.

Bakersfield.—Oil production of the State in April totaled 276,471 bbl. daily, an increase of 9000 bbl. over March. There were 8248 producing wells, 48 new ones being completed. Stocks on April 30 were 30,502,447 bbl. These have dropped 1,948,018 bbl. in 4 months.

Grass Valley.—Up to March 1, 1918, the Golden Center mine here has produced gold worth $355,224. During five years over 11,000 ft. of development has been done. C. A. Brockington has retired from the management in favor of A. Cadogan. The former was largely responsible for reopening this mine.

Oroville.—The Pacific Gold Dredging Co. has ceased operations in this field, but will maintain its office here to manage the Butte Creek, Yuba River, and Trinity River boats.

Plymouth.—The Plymouth Consolidated Gold Mines reports as follows, covering operations during 1917:

Sales of gold and concentrates, and sundries, totaled $686,000. Operations in California cost $433,000. London charges, American taxes, depreciation, etc., amounted to $82,000. The profit was therefore $171,000. Adding the balance of $53,000 from 1916, there was available



MAP SHOWING PRINCIPAL CENTRES IN AMADOR COUNTY, CAL.

$224,000. Two dividends of 24c. each totaled $115,000. After deducting income-tax, the balance carried forward to 1918 was $86,000. Development totaled 5017 ft. The main shaft was deepened 152 ft. on the incline, and at 2600 ft. a station and ore-bin were excavated. The most important result was the discovery of the north foot-wall ore-shoot on the 2150 and 2300-ft. levels. On the former there is 177 ft. of ore, 48 in. wide, averaging $6.24 per ton. A rise above this disclosed 57 in. of equal value. At 2300 ft. there is 140 ft. of $8.24 ore across 96 in. The widest part is 26 ft. across. On the 2000-ft. level prospects are good. On the bottom level—2600 ft.—the main east cross-cut showed 60 in. of $4.44 ore, the south drift 39 in. of $6.96 ore, and the north foot-wall drift 12 in. worth $4.44 for 15 ft., then 72 in. worth $2.76 for 56 ft. Ten levels contributed to the output of 127,750 tons. The mill extracted $3.72 by amalgamation and $1.56 by concentration, a total of $5.28, equal to 86.37% on the average of $6.12. Residue assayed 84c. per ton. The bullion yield was 32,795 oz. gold and 7688 oz. silver. As the tailing assayed higher than before, due to a change in nature of the ore, two Hardinge mills and more copper plates were added. Costs were 46c. for development, $2 for mining, 38c. for milling, 24c. for bullion and concentrate expenses, and 31c. for maintenance and general, a total of $3.39 per ton. J. F. Parks is superintendent.

Sonora.—The Hope Mines Development Co. has issued a statement wherein it appears that its revenue in 1917 amounted to $90,682, of which $74,352 was from bullion and ore. Expenses were $90,682, including $4698 on dividend account. George Weston is manager.

Redding.—Lawrence Gardella's dredge No. 2 on Clear creek has been started. This is the third boat near here.

COLORADO

Cripple Creek.—Report of the Cripple Creek Central Railway, holding company for the Cripple Creek & Colorado Springs Railroad Co. and the Midland Terminal Railway Co., covering 1917 and the last half of 1916, shows that the Cripple Creek Central paid $270,000 in dividends last year and $135,000 in the last half of 1916. Cash at December 31 last was $531,088, an increase of $120,000 during the year. The freight carried was 151,590 tons less in 1917 than in 1916. Operating expenses for 1917 was $146,661 less.

Vindicator Consolidated reports a profit of $125,000 for the first quarter of 1917. Cash balance on April 19 was $160,887, plus $20,000 for ore in transit. Development was stopped for good in the lower levels. Considerable work done showed that it was useless to proceed farther. Operations for the period showed a substantial improvement over those for the last quarter of 1917. Ore coming from stopes was of much better average grade, the new ore-house is a distinct success, and the mill is making a moderate profit. A substantial improvement has also occurred in lease operations over conditions existing last fall. More lessees are at work, and several of them have opened excellent ore, from which the company is deriving substantial royalties.

Idaho Springs.—At the west end of Clear Creek county between Georgetown and Silver Plume the Wide West Mining Co. has laid 2700 ft. of the Hall tunnel with 46-lb. rails. The heading is to be driven 500 ft. farther. The Dorothy vein is being opened for extraction of ore. J. Terry is manager of this company, whose prospects are considered good.

Leadville.—Manganese ore exposed on the 465-ft. level of the Bohn shaft, right in town, is 13,500 tons; but the probable production is several times this amount. In April 500 tons shipped assayed from 34 to 37% Mn.

Nederland.—Rich silver-lead ore has been opened in the Conger Chief mine.

The Royal Gem company is starting work on a large scale.

The Bismark shows rich lead-silver-copper ore.

Lakewood is the busiest tungsten district of this field at present. The Primos company is working at full capacity.

At Cold Springs the Wolf-Tongue company is mining large quantities of tungsten ore. The mill at Nederland is working full time.

Silverton.—The aerial tramway at the Lackawanna mine is ready for operation. It is of the Bliechert type, 3700 ft. long. The company expects to employ 30 men at the mine and at the Silver Lake custom mill, which has been leased. One hundred tons per day will be treated on two shifts. C. B. Sheehan is manager of the property, which the D. L. & W. Co. apparently intends to develop into a year-round shipper. Recently rich ore was uncovered, 15 to 18 ft. thick, extending to a depth of several hundred feet. Immediate prospects seem bright.

The Telescope Mining Co. has 8 men clearing tunnels, preparing for the coming season. Ore carries lead and silver.

IDAHO

Hailey.—The North Star and Independence mills of the Federal M. & S. Co. have been re-modeled and put into service again. The former dresses a lead-silver-zinc ore, the latter lead-silver ore. These mines are a mile apart in a direct line.

Moscow.—In co-operation with the U. S. Bureau of Mines, the University of Idaho, through the generosity of the mine-owners of the State, offers in the School of Mines a number of fellowships in metallurgy. These are open to college graduates who have had good training in chemistry and metallurgy, and who are qualified to undertake research work. The income of each fellowship is $720 per year of 12 months beginning July 1, 1918. Fellows will register as students in the university and become candidates for the degree of master of science in mining or metallurgy (unless this or an equivalent degree has been earned). Their class work will be directed by the heads of the departments of instruction, but the greater portion of their time will be spent in research work under the direction of the Bureau staff resident at the University. The purpose of this work is to undertake the solution of definite problems confronting the mining and metallurgical industries of Idaho. For 1918-'19 the following subjects are to be investigated: (1) Differential flotation, with especial reference to the zinc-lead ores of the Coeur d'Alene; (2) availability of Western wood-oils for concentration by flotation; and (3) treatment of the complex gold-silver ores of southern Idaho. Under the ruling of the War Department, candidates 21 years of age or over who are accepted for the fellowship, will be allowed to enlist in the Engineers Reserve Corps detailed to continue their studies, and placed in a deferred classification for the period of their enrollment as graduate students.

KANSAS

Baxter Springs.—Production of the Baxter-Treece districts last week was 1375 tons of blende and 173 tons of lead, valued at $79,485.

MICHIGAN

Houghton.—Ore production of many of the Copper Country mines fell off considerably last month, as shown by the following table, in tons:

Mine	April	March
Ahmeek	101,500	118,000
Allouez	41,200	49,000
Centennial	11,000	13,000
Copper Range group	95,000	.....
Franklin	25,000	25,000
Hancock	12,800	16,000
La Salle	13,000	13,000
Mass	17,300	24,800
Mohawk	39,000	42,000
Osceola	87,000	105,000
Superior	10,500	9,400
Wolverine	20,000	25,000

Shortage of trammers and celebration of the conclusion of the 'wet' status of Michigan are said to be responsible for the lower tonnage.

Calumet & Hecla is to abandon the coal docks near Dollar bay on Portage lake, and will use the new and larger plant near Hubbell, on Torch lake. The fire at the old coal shed last winter resulted in a loss of $170,000.

Part of the 10,000-ft. Nordberg hoist has been received at the Quincy mine. Foundations for this were partly laid last summer and are now being finished. This No. 2 shaft has to go 14,000 ft. before the property-line is reached. Stage hoisting has been suggested for depths below 7000 ft., but the Quincy will use the new engine for continuous hauling from 10,000 ft., if such depth can be attained. Bruno Nordberg is satisfied that the hoist will be satisfactory, in spite of the heavy rope needed and 10-ton skips.

Quincy Mining Co. has increased wages similar to Calumet & Hecla. Employees paid under $200 per month receive 5% extra from May 1.

MISSOURI

Flat River.—On June 20 the St. Joseph Lead Co. pays 50c. per share.

Joplin.—Production of the region last week was 7773 tons of blende, 155 tons of calamine, and 1361 tons of lead. These averaged $54, $30, and $82 per ton, respec-

tively. The total value was $523,843, making $9,089,200 for 19 weeks. The Missouri field contributed $105,930.

According to W. W. Wampler, a mine operator of Webb City for many years, one improvement for this district would be a standardized method of making assays of drill cuttings. So many different methods are used that it is difficult to tell what to make of assays if one does not know just how the cuttings were handled.

Stark City.—Another zinc-lead field is coming to notice in Missouri, it being in prairie country south of Neosho. The Stark City Lead & Zinc Co. has a new 200-ton mill almost complete. Ore is opened at 65, 90, and 190 ft. depth, all of good grade. Other companies have good prospects.

MONTANA

Anaconda.—A new stack is being built at the Washoe Reduction Works. It will use 7,000,000 bricks made from mill slime. The height is to be 525 ft. above the 30-ft. concrete foundation. The inside diameter is 60 ft. At its base will be a battery of Cottrell electric dust precipitators.

Butte.—On account of the accident to its Black Rock shaft, whereby a skip tore out 200 ft. of timber, Butte & Superior's mill is still stopped, until No. 3 shaft can be operated.

North Butte Mining Company reports as follows for 1917: In the Butte east side mineral area, eight claims were acquired. These probably carry the eastern extension of veins that have been opened in properties contiguous to the land purchased. The general manager, Norman B. Braly, states that the cross-cut tunnel in this section was driven 1448 ft., making it 2500 ft. long. Small bunches of high-grade ore were found. A 4-compartment shaft is being sunk 700 ft. in the Sarsfield claim, to connect with the tunnel workings. At the North Butte mine, work was suspended at the Granite Mountain shaft on June 8, 1917, when fire destroyed it to a depth of 1400 ft. By January 1918 this shaft was lined with concrete. Meanwhile the Speculator shaft was used for hoisting a small quantity of ore. New work last year amounted to 12,175 ft. On the 3200, 3400, and 3600-ft. levels of Granite Mountain shaft there was driven 415, 461, and 354 ft. respectively. Results were generally satisfactory. The smelter treated 296,750 tons of ore and 23 tons of copper precipitate. This yielded 14,493,452 lb. copper, 662,846 oz. silver, and 959 oz. gold. There was treated 5770 tons of ore producing 1,222,482 lb. zinc and 8801 oz. silver. Sales included 21,087,513 lb. copper, 1,222,482 lb. zinc, 987,120 oz. silver, and 959 oz. gold. The gross income was $4,615,217. All expenditures totaled $3,974,090, leaving a profit of $641,127. Four dividends absorbed $1,075,000, equal to $2.50 per share. Current assets at December 31, 1917, were $2,190,149, including Liberty Bonds $90,000, cash $1,202,329, and metals on hand $707,969. Current liabilities were $184,349. The surplus of $5,287,013 was reduced to $3,465,270.

Contact.—A chrome deposit, assaying from 32 to 47% Cr_2O_3, has been discovered 32 miles from Big Timber by T. Rowlands and others, who have bonded it to Barker & Pardy of Great Falls for $50,000.

NEVADA

Copperfield.—Smelter settlement of the last carload of ore shipped from the Nixon-Nevada mine shows that it averaged 33.36% copper, $10.80 gold, and $13.98 silver per ton. The net return from the copper alone was $136.28 per ton. The ore was sorted into two grades of nearly equal size, and the management estimated that the first-class would carry 40% and the second-class 20%. The smelter inadvertently mixed the two grades and sampled it as one lot, but the result shows that the Nixon management was conservative.

Goldfield.—The Red Hill Florence and Florence Goldfield companies have signed an agreement that eliminates any chance of litigation over apex rights. By the terms of the agreement the Red Hill is granted a lease for five years on all ground of the Florence company that is desired or that can be worked to advantage by the Red Hill, embracing the greater part of the Red King claim and excluding only a small area under lease and not covering the same ore-channel.

Silver Pick Consolidated Company is to sink its shaft from 1100 ft. to 1400 ft., owing to favorable indications.

Atlanta Mines Co. during its financial year ended April 1 shipped 1821 tons of $16.23 gold-silver-copper ore. This gave a net return of only $4.63 per ton from the smelter. The ore was not suitable for treatment by flotation at the Goldfield Consolidated mill. The shaft was sunk from 1750 to 1900 ft., where at present cross-cutting is under way. Water and other matters delayed this work, but the objective is considered to be close at hand. A raise put up 40 ft. from the bottom level has cut the foot-wall of the vein, assaying $11 across 7 ft. A. I. D'Arcy is manager.

Goodsprings.—Mine-owners in this district are said to be storing their zinc ore in anticipation of a rise in prices. This district is described on another page of this issue.

Pioche.—Amalgamated Pioche is employing a considerable force on a lease, concentrating sulphide ore carrying 12% lead, 12% zinc, and 10 oz. silver per ton.

The Bristol-May, at Jack Rabbit, 15 miles north of Pioche, is shipping lead-silver-copper ore. This mine is near the top of a mountain. An aerial tram brings ore to the bins, above the narrow-gauge railroad.

The Black Metals Co. at Jack Rabbit has shipped one car of manganese, and is cleaning out some old workings filled with this ore. When mining for lead-silver, the manganese is screened and sold to Utah smelters for fluxing purposes. The company receives 10c. per unit for it, besides 5% lead and 6 oz. silver per ton.

The Prince Consolidated is shipping over 300 tons daily to Utah smelters.

Tonopah.—Production of the district last week was 10,261 tons of ore valued at $180,557.

Tonopah Extension in April produced 106,427 oz. silver and 1089 oz. gold from 8529 tons, giving a profit of $62,471. Considerable work is under way in the company's Victor mine.

Jim Butler made a profit of $38,835 in March. In April 2542 tons was treated.

North Star has opened rich ore in the 1000-ft. intermediate level, near the Belmont boundary. A. E. Lowe is superintendent.

The Halifax Tonopah may absorb the Mizpah Extension, as the matter is under consideration.

West End Consolidated made a profit of $354,264 during 1917. Reserves are 10,333 tons of positive, 35,905 tons of probable, and 61,111 possible ore. Work is to be started on the 800-ft. level.

Tybo.—The Louisiana Consolidated Mining Co. is operating here, 55 miles north-east of Tonopah, which is the shipping point. In the early days about $5,000,000 of oxidized lead ore was mined. After having been shut-down for a number of years work has been resumed by the present company. Exploration has developed new lead-silver orebodies in limestone to a depth of 500 ft., and sufficient ore has been blocked out to warrant a mill. This has had a trial run, and concentrate will be shipped soon.

Virginia City.—Five north-end Comstock mines are now producing ore, an unusual occurrence. These are the Union Con., from the 2300, 2400, 2500, and 2600-ft. levels; Sierra Nevada, from 2500-ft.; Mexican, from 2300-ft. level near the Union south line; and Ophir and Consolidated Virginia, from the 2000 and 2100-ft. levels.

NEW JERSEY

Franklin.—New Jersey Zinc Co.'s net income for the first quarter of 1917 was $3,603,796, against $6,006,739 a year ago. Provision for Federal taxes was $1,620,000.

OKLAHOMA

Henryetta.—The United Producers Smelting Co. is making good progress in erecting its zinc smelter and rolling-mill here. J. R. Cavanagh is one of the principals.

Picher.—Production of Oklahoma fields last week was 4619 tons of blende and 848 tons of lead, valued at $338,438.

OREGON

Gold Hill.—Three extensive deposits of manganese have been uncovered on the Pacific & Eastern railway in the Butte Creek district, at the east end of Jackson county. Two are within two miles of a shipping point, and are on the same strike of the Lake Creek deposits a few miles south. The Tacoma, Washington, company, operating on Lake creek, is making regular shipments of concentrate and is erecting an additional unit to its plant. The company is drill prospecting its adjoining holdings, which are said to show a large tonnage of good quality ore.

The new owners of the defunct Rogue River Public Service Corporation properties, consisting of power-plants at Gold Hill and Grants Pass on Rogue river, have incorporated under the name of the Irrigation & Power Co., with headquarters at Grants Pass. The new company is composed of Indianapolis, Indiana, citizens, with Frank M. Fauvre at the head. Rehabilitation and operation of the properties will be resumed at once.

SOUTH DAKOTA

Lead.—On May 25 the Homestake company pays 50c. per share.

The Homestake Mining Co. has announced discontinuance of the percentage bonus, which has been added to regular wages, and the adoption of a new permanent wage-scale, also an increase to the scale to present employees for the period of the War only, as follows:

Old scale	New scale	War scale
$2.50	$3.00	$3.25
2.75	3.25	3.50
3.00 ..... Surface	3.50	3.75
3.00 ..... Underground	3.60	3.85
3.25	3.75	4.00
3.50	4.00	4.25
3.75	4.25	4.50
4.00	4.50	4.75
4.25	4.75	5.00
4.50	5.00	5.25
4.75	5.25	5.50
5.00	5.50	5.75

Terry.—The Mogul-Ofer tunnel is in 850 ft. and will be continued 600 ft. farther. When completed it will make possible the handling of all ore from the upper workings, through chutes, at the tunnel-level. Ore will be drawn from the chutes and transported by mine-cars to the bins at the portal, from there delivered to the mill-bins by aerial tram. Erection of the tram has been completed, but until the tunnel is finished only part of the ore can be removed by this means.

Trojan.—Oberton and Arpino have leased the Juno mine and are making regular shipments to the Mogul mill.

Galena.—Charles Allen has leased the Red Cloud mine, and shipments of silver-gold ore will be made to the Trojan plant as soon as roads can be repaired.

TEXAS

Pecos.—Sulphur deposits here are to be developed. The Standard Sulphur Corporation of Detroit, Michigan, has ordered rails and rolling-stock for a 12-mile line to its sulphur mines.

UTAH

Bingham.—Utah Copper Co. reports as follows for the first quarter of 1918:

The net profit, including dividends, etc., from other interests, totaled $3,810,664. Dividends paid were $4,061,225, leaving a deficit of $250,561 for the period. In the last quarter of 1917 there was a surplus of $3,655,069. Overburden removed amounted to 888,690 cu. yd. The mills dressed 2,498,700 tons of 1.2218% ore, a decrease of nearly 1,000,000 tons in the last quarter. Recovery was 66.80%, against 59.15%. Including ore smelted direct the output was 41,276,750 lb., compared with 51,269,465 lb. Cost per pound was 14.09 cents.

The Bingham-New Haven-Utah Consolidated apex and damage suit is to be settled out of court.

Lark.—The first two units of the Ohio Copper Co. were started last week. They have a capacity of 600 tons each. Three others will be ready by July 15. Flotation is used.

Tintic.—The Tintic Milling Co. reports for 1917 that sales of bullion realized $542,265. Operations cost $491,444. Depreciation and interest left a net profit of $12,922. Current assets total $148,640, and liabilities $149,521. The surplus after closing the year's business was $7716.

WASHINGTON

Keller.—Fluorspar claims of H. C. Mitchem of Spokane have been optioned to the Consolidated Mining & Smelting Co. of Canada for $100,000.

WYOMING

A bill to appropriate $50,000 for a mining experiment station at Sheridan has been introduced to Congress by Representative Mondell. The main object of the station would be to investigate the fuel possibilities of lignite.

CANADA

Anyox.—Granby Consolidated is erecting two new converters here. These were ordered a long time ago. Four furnaces are in blast.

Ontario

Cobalt.—The Mining Corporation of Canada is altering its mill to allow of treatment of 300 tons daily of old tailing from the bed of Cobalt lake. It has been proved that the slime from previous operations can be treated by cyanide to better advantage than by flotation. The material pumped from the lake will be first classified, the slime treated in the cyanide section of the mill, and sand, after re-grinding in tube-mills, run over concentrating tables and through flotation apparatus.

MEXICO

Sonora

Cananea.—Greene Cananea pays $2 per share on May 27. This is payable only on the $100 shares into which the capital stock is divided.

Mexico City.—The United States Federal Reserve Board has denied application of the A. S. & R. Co. to increase its gold shipments to Mexico. For the last several months the company has been shipping gold bars at a rate above $500,000 monthly, in obedience to a decree of the Mexican government that mining companies shipping gold and silver out of Mexico in ore and base bullion must return 25% of the value of the silver in form of refined gold. Under a recent ruling the amount of gold return demanded for silver taken out of Mexico was increased to 50%. Permission was denied, on the ground that under the existing arrangement, Mexico is receiving all the gold that the country needs. Company officials will submit word to the Mexican government of their inability to supply the demanded gold increase, and it is hoped that authorities at Mexico City will revoke the new decree.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

T. A. Rickard is at Salt Lake City.

Walter G. Perkins is at New York.

F. L. Bosqui has returned to London.

James H. Hyde is doing research work at the University of California.

W. A. Butchart, concentrating engineer of Denver, was here this week.

Roy J. Handy is expected in San Francisco next week, from Kellogg, Idaho.

Charles F. Willis has resigned as director of the Arizona State Bureau of Mines.

R. C. Gemmell, manager for the Utah Copper Co., has been in San Francisco.

D. C. Jackling, now director of explosive-plants, was in San Francisco this week.

Morton Webber has opened a branch office at O'Rourke Estate Bdg., Butte, Montana.

R. A. F. Penrose succeeds **Eugene Meyer** on the directorate of the Utah Copper Company.

Norman C. Stines is reported to be a prisoner of war, taken in Finland and now in Germany.

H. C. Wilmot has returned to New York from a two months trip in New Mexico and Arizona.

G. M. Colvocoresses, manager of the Humboldt smelter, in Arizona, was in San Francisco this week.

J. B. Kendall has resigned as mine superintendent for the Goldfield Consolidated, to take effect June 1.

Albert Burch is in charge of investigations into the production of chrome for the U. S. Bureau of Mines.

H. Vincent Wallace has opened an office as consulting mining engineer in the Central Bdg., Los Angeles.

Wilbur A. Nelson has been appointed State geologist of Tennessee, filling the place of the late **A. H. Perdue.**

H. Smeddle, Lieutenant of the 15th Battalion, Tank Corps, British Army, has been promoted to Captain.

Edwin A. Sperry, of the department of metallurgy, in Pei-Yang University, at Tientsin, is returning to China.

C. W. Beauchamp, of Twin Bridges, Montana, is in the 28th Regiment of Engineers, Company D, at Wood Bridge, Virginia.

Herman Garlichs has been appointed member of the Advisory Committee on Non-Ferrous Metals to the U. S. Tariff Commission.

Thomas J. Taplin passed through San Francisco on his way from the Spassky mine, in Siberia, to England, where he intends to enlist.

William M. Keck has been appointed consulting engineer for the Department of Petroleum and Gas of the California State Mining Bureau.

H. W. Foster has resigned as assistant manager to the El Tigre Mining Co., Sonora, Mexico, to enter the Fourth Officers Training Camp.

F. H. Probert, Professor of Mining in the University of California, has gone to Washington to do some important work for the U. S. Bureau of Mines.

F. J. Nagle, recently superintendent of the Vindicator mine at Cripple Creek, has been appointed manager for the Sunnyside Mining Co., at Silverton, Colorado.

Ernest L. Hartwell, formerly assistant-superintendent for Yak Mining, Milling & Tunnel Co., at Leadville, Colorado, succeeded **Hugh C. Watson** as superintendent.

W. E. Greenawalt, of Denver, has been engaged by the Nevada-Douglas Consolidated Copper Co. to act as metallurgist, while **G. C. Westby** of Butte is to do testing work.

Harold A. Lewis has resigned as manager to the Porco Tin Mines, Ltd., at Potosi, and is now consulting engineer to the Berenguela Tin Mines, Ltd., at Cochabamba, also in Bolivia.

H. H. Webb has been making a visit of inspection at the La Grange mine, near Weaverville, California. His nephew, **T. H. Webb**, the son of Louis Webb, the manager of the La Grange, was the airman that carried mail recently from New York to Washington.

Vernon F. Marsters, formerly geologist to the New York & Honduras Rosario Mining Co., San Juancito, Honduras, has opened an office as consulting engineer in the Rialto Bdg., at Kansas City; he is now in Louisiana engaged in the investigation of some oil properties in the Caddo field.

Walter W. Bradley, mining statistician of the California State Mining Bureau, received the degree of mining engineer, and **E. V. Daveler**, superintendent of mills, Alaska Gastineau Mining Co., at Juneau, the degree of metallurgical engineer, at the Commencement of the University of California, on May 15.

Samuel W. Cohen has resigned as general manager for the Crown Reserve Mining Co., Ltd., and Porcupine-Crown Mines, Ltd., which position he has held for ten years, to take up general consulting mining engineering practice with headquarters at Montreal. He remains with both these companies as consulting engineer.

Recent promotions at the Anaconda Copper Mining Co.'s works are as follows:

W. N. Tanner, for a number of years superintendent of the foundry department, and chief engineer of the reduction works, has been promoted to be chief mechanical engineer with headquarters at Butte. **C. D. Woodward**, formerly assistant chief engineer at the Great Falls reduction works, has been promoted to be chief electrical engineer, with headquarters at Butte. **W. C. Capron**, assistant chief engineer at the Washoe reduction works, has been promoted to be mechanical superintendent of the plant. **George Tryon**, formerly chief draftsman at the Washoe works, has been promoted to be assistant chief engineer of the Great Falls works. **W. E. Meals**, formerly superintendent of construction at the Washoe works, succeeds Mr. Tryon as chief draftsman. **W. Jurdon** has been promoted from draftsman to superintendent of construction, succeeding **W. E. Meals.**

Thomas D. Kyle, well known in Colorado, died at Glenwood Springs, on April 18, after a short attack of pneumonia. He was born at Lynchburg, Virginia, on November 25, 1872. He graduated from the University of Virginia, where he secured special training in chemistry and metallurgy. Arriving at Leadville in 1892, two years later he opened an assay-office there that was maintained until his death.

The Michigan College of Mines 'Alumnus' for April gives a list of 177 M. C. M. men in the Service.

The fourth National Exposition of Chemical Industries is to be held at New York, starting on September 23. Charles F. Roth is manager.

The American Association of Petroleum Geologists was formed at Oklahoma City on February 15. The new organization is largely a change of name and widening of scope of activities of a highly successful local organization, the Southwestern Association of Petroleum Geologists, in existence for three years. Over 100 geologists from various parts of the country were present, including James F. Kemp, I. C. White of Tampico, Thomas M. O'Donnell of the Fuel Administration, R. D. Salisbury of the University of Chicago, and others. Instructive papers were read. The officers elected for the current year were president, Alexander Deussen; vice-president, I. C. White; secretary-treasurer, W. E. Wrather; and editor, Charles H. Taylor.

THE METAL MARKET



METAL PRICES

San Francisco, May 21

Aluminum-dust, large and small lots, cents per lb.	65—70
Antimony (wholesale), cents per pound	15
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7½—8¼
Platinum, pure and with 10% iridium, per ounce	$108—$116
Quicksilver, per flask of 75 lb	$110
Spelter, cents per pound	9¼
Zinc-dust, cents per pound	17½

The Government is making an inventory of the platinum metals in the country and will pay $105 per oz. for platinum, $175 for iridium, and $135 for palladium.

ORE PRICES

May 21

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38% and over, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton (nominal price)	$7.00—$8.00
Manganese, 40 to 50% Mn, Hazen, Nevada, cents per unit	92—110
Manganese, 48%, New York, per unit	$1.20
Molybdenite, per lb., 85% MoS_2	$1.25—$1.50
Pyrite, domestic, New York, cents per unit of sulphur	28
Tungsten, 60% WO_3, California, per unit	$24

EASTERN METAL MARKET

(By wire from New York)

May 21.—Copper is unchanged. Lead is dull, though firm. Spelter is quiet but strong. Platinum is not quoted.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67c. for small lots, effective until June 1, 1918. Quotations in cents per pound are as under:

Date		Average week ending	
May	15	Apr. 9	23.50
"	16	" 16	23.50
"	17	" 23	23.50
"	18	" 30	23.50
"	19 Sunday	May 7	23.50
"	20	" 14	23.50
"	21	" 21	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	23.50	Oct.	28.50	23.50	....
May	29.02	31.89	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Copper production of some of the larger mines in April are as under:

Name	Pounds	Name	Pounds
Braden	4,722,000	Granby	3,048,012
Calumet & Arizona	4,374,000	Inspiration	9,350,000
Calumet & Hecla and subsidiaries (C. & H 50%)	11,734,820	Kennecott	5,794,000
		Mohawk	944,302
		New Cornelia	3,728,000
Chile	7,770,000	Wolverine	391,989
Davis-Daly	669,366		

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to make prompt settlements with smelters and brokers, producers allow a discount from the Government price of $1, hence the lower price. The Government has not fixed the general market price at $1, but will pay this price for all silver purchased by it. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the current rate of exchange.

Date	New York, cents	London, pence	Average week ending	
May 15	99.50	48.87	Apr. 9	91.74
" 16	99.50	48.87	" 16	93.73
" 17	99.50	48.87	" 23	97.35
" 18	99.50	48.87	" 30	99.66
" 19 Sunday			May 7	99.52
" 20	99.50	48.87	" 14	99.50
" 21	99.50	48.87	" 21	99.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

At the end of last week the melting of silver dollars at the New York Assay Office was stopped, owing to the lack of silver certificates. It is now proposed to ship the coins without melting, by mutilating them as prescribed in the new Act.

Samuel Montagu & Co. of London, writing on April 25, say that the price has now reached a point at which silver costing $1 per fine ounce on the other side of the Atlantic can be supplied to this (London) market at a reasonable profit (insurance, freight, etc., included). Unless something unexpected happens, future movements of the price are likely to be on a very limited scale. Important legislation passed by the U. S. government, which, while demonstrating the cordial co-operation in finance between it and Great Britain, relieves the strain of providing silver for Indian coinage. The bill grants power to melt 350,000,000 silver dollars (about 271,000,000 fine ounces), and to dispose of the bullion, to be replaced by subsequent purchases. As information has been cabled from India that the Indian government has secured 150,000,000 oz. from the U. S. government, a further 121,000,000 oz. is available for such purposes as America may decide. The amount of 150,000,000 oz. is sufficient to provide 4363 lacs (1 lac = $32,000) of rupees, a sum that should be adequate to meet currency demands for some considerable time. It was announced in Parliament on April 24 that 198,000,000 fine oz. had been purchased for coinage between February 1915 and March 31, 1918 (average price 39.03d.). The holding of silver by the Indian Treasury on January 31, 1915, was 3030 lacs, and on March 31, 1918, 1079 lacs—a reduction of 1951 lacs. As 198,000,000 oz. can be minted into 5760 lacs of rupees, the net absorption in the period mentioned was 7711 lacs. Therefore even at the high rate of absorption indicated, 150,000,000 oz. would suffice to maintain the silver holding at the same level for about 21½ months.

The stock in Shanghai on April 20 consisted of 32,600,000 oz. in sycee and 14,700,000 dollars, compared with about 32,250,000 oz. and 14,700,000 dollars on April 13.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. In February 1918 the Government fixed prices for grade A spelter at 12c. per lb. for itself and the open market. This grade constitutes only a small proportion of the total output. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c. per pound.

Date		Average week ending	
May	15	Apr. 9	7.23
"	16	" 16	7.00
"	17	" 23	7.00
"	18	" 30	6.88
"	19 Sunday	May 7	7.00
"	20	" 14	7.21
"	21	" 21	7.41

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Second-grade ore at Joplin is $2.50 per ton higher at $42.50. The market shows signs of betterment.

Zinc production of Butte & Superior in April was 14,100,000 lb., also 250,000 oz. of silver.

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date		Average week ending	
May	15	Apr. 9	7.13
"	16	" 16	7.00
"	17	" 23	6.95
"	18	" 30	6.83
"	19 Sunday	May 7	6.72
"	20	" 14	6.73
"	21	" 21	6.92

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.28	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date		Date	
Apr.	23 115.00	May	7 110.00
"	30 115.00	"	14 110.00
		"	21 110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115.00	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

There have been sales of Chinese tin in New York at 99¼c., while Straits is nominal at $1.05 per pound.

Eastern Metal Market

New York, May 15.

Two of the markets exhibit a stronger tone and have developed higher prices, but all of them are inactive as compared with a normal market.

Copper is in strong demand and rather scarce for May delivery.

Tin is at a standstill with few transactions recorded or possible. Prices are no higher than a week ago.

Lead is not so plentiful and is firmer and higher.

Zinc, while not particularly active, is higher and displays a firm undertone.

Antimony has declined.

Aluminum is under Government control.

In the steel world the capacity in all lines is ample, but it is the spectre of a short supply of fuel that lies behind the predictions of long continued monopoly of the steel output by the Government. Ingot production in April was at the yearly rate of 43,000,000 tons, which would mean a considerable surplus above war needs, direct or indirect. Interesting news is the selection of Neville Island, near Pittsburgh, as the site for the great gun and projectile plant to be built by the Government and the Steel Corporation. It means the early letting of large orders for structural steel and equipment. Guns will not be turned out for 18 months, but the plant will cost $60,000,000 to $70,000,000. Ship-plates and shell-steel programs have been expanded in the past week. Pig-iron is under close Government control as to sale and distribution, and the inability of cast-iron pipe makers to get enough iron to keep going is a serious question.

COPPER

There is little news; the entire trade is eagerly and somewhat anxiously awaiting the outcome of the meeting at Washington on May 22, when the final discussion will take place as to any change in the 23.50c. price of copper, effective until June 1. It is estimated on good authority that if the average small producers is forced to shut-down through the paring of profits to the vanishing point by reason of rising costs, there will be a loss in the output of not less than 100,000,000 lb. per year. This is not a negligible quantity as consumption goes now-a-days. Demand for May delivery, from British and French consumers particularly, and from others as well, is so large that there is doubt whether the refiners can meet it. Demand from all quarters is good but there is not much disposition to book orders far ahead until the supply and the demand are accurately analyzed. The output of two or three large companies for the first quarter is not as large as that of the last quarter in 1917. Many confidently predict an advance over the present Government price of perhaps ¾ to 1½c. per lb., making it 24.25 to 25c. per lb. after June 1. At least no reduction is probable, in view of all the conditions.

TIN

For the first week in a long time there have been no advances in prices; they have gone to what has seemed the high mark; they may go higher yet, but they have stopped temporarily. The week has been quiet, and it is expected that the inactivity will continue. Small quantities of tin for future shipment from the Far East have been sold at 97 to 98c., principally May, June, and July delivery. These offerings, while few, have been quickly snapped up, and more could have been disposed of had they been offered. The metal is still scarce for any position, and the situation is not reassuring. For spot delivery as high as $1 or $1.05 is the nominal quotation, and this would readily be paid for any offerings. An unconfirmed rumor states that $1.25 was offered for a 10-ton lot of Straits tin for prompt delivery, and this is highly probable. Arrivals to May 14 inclusive have been 645 tons, with 5000 tons estimated to be afloat. The London market is easier, with spot Straits quoted at £370 per ton, a decline of £11 in the last week.

LEAD

The feature of the lead market is the fact that offerings of prompt lead are scarce. With quotations up to 6.90c., New York, or 6.70c., St. Louis, yesterday for early delivery the market is considerably stronger than a week ago. The cause is that the lead that certain sellers were pressing on the market in the last few weeks has been absorbed, resulting in more buyers than sellers. The stronger position has been developing gradually, and it is a question whether it is temporary or not. Opinion is divided as to this. The present outside quotations are again close to that of the American Smelting & Refining Co. of 7c., New York, which has remained unchanged for some time.

ZINC

The better tone noted in last week's letter has continued to develop until now the market is quite a little stronger. For early delivery of prime Western 7.25c., New York, or 7c., St. Louis, is asked and obtained, with as high as 7.37½c., St. Louis, wanted by some sellers. The quotation for June is 7.37½c., St. Louis. While there are inquiries for third quarter, there is little disposition to sell as far ahead. The Government has been a large buyer of grade A and is now inquiring for more, as well as for 1000 tons of grade C. These demands have contributed to the stronger position. Another cause of the higher levels is the fact that considerable metal was taken out of the market at the recent low levels and sellers are not now eager to sell at present levels and on an apparently rising market.

ANTIMONY

Because some sellers offered holdings at a considerable concession from prevailing prices the market has declined and is quotable at 12.50 to 12.75c., New York, duty paid, for Chinese and Japanese grades.

ALUMINUM

Government prices continue to control the sale of No. 1 virgin metal, 98 to 99% pure. These range from 32 to 32.20c. per lb. in lots of 50 tons down to one ton.

ORES

Antimony: The market is entirely inactive, with prices nominal at unchanged levels.

Ferro-manganese: It has been virtually decided to permit the importation of about 10,000 tons of British ferro-manganese inside of the next two months before completely shutting off the imports as planned for May 13. This is due to the fact that ore imports in April will be unusally low.

Manganese: It is interesting to note that of the 19,300 tons of March imports of high-grade ore, about 10,000 tons came from Cuba and only 6000 tons from Brazil.

Molybdenum: Sales have been made at $1.25 to $1.50 per lb. of MoS_2 in 90% material, depending on the quality. These prices are being shaded on large quantities.

Tungsten: The week has been quiet. What little business was done is reported to have gone at the usual prices of $24 to $24.50 per unit in 60% concentrates. Ferro-tungsten is unchanged at $2.25 to $2.35 per lb. of contained tungsten.

Company Reports

CALUMET & HECLA MINING CO., AND SUBSIDIARIES

Properties: situated in the Copper Country of Michigan.

Operating Officials: (C. & H.) general manager, James MacNaughton; assistant superintendent, W. M. Gibson; chief mining captain, John Knox; mill superintendent, Henry Fisher; metallurgist, C. H. Benedict; and smelter superintendent, H. D. Conant. (Ahmeek) superintendent, S. R. Smith; mining captain, Thomas Rapson; and mill superintendent, A. L. Burgan. (Allouez) superintendent, F. W. Ridley; and mining captain, J. J. Gibbens. (Centennial) mining captain, J. H. Chynoweth. (Isle Royale) mine superintendent, J. E. Richards; chief mining captain, Edward Colenso; mill superintendent, A. G. Andrews. (La Salle) superintendent, O. Hallingby; mining captains, William Skewes and Josiah Bartell. (Osceola) superintendent, F. H. Haller; mining captains, James Rowe, Joseph Discombe, and Frank Lands; and mill superintendent, A. L. Burgan. (Superior) superintendent, Ocha Potter. (White Pine) superintendent, T. H. Wilcox.

Financial Statements: the year 1917 shows the following results:

Company	Copper sales	Operating profit	Balance Jan. 1, 1917	Balance Dec. 31, 1917
Calumet & Hecla	$16,900,576	$9,154,450	$10,758,602	$10,626,485
Ahmeek	5,180,901	3,362,590	2,233,364	1,505,444
Allouez	2,051,297	1,035,630	1,545,814	1,157,703
Centennial	454,123	139,597	448,368	436,107
Isle Royale	2,750,627	1,139,745	923,552	890,740
La Salle	440,151	128,592	173,492	308,842
Osceloa	3,453,758	1,736,915	2,677,549	2,410,190
Superior	469,721	199,939	434,313	489,293
White Pine	860,523	404,673	613,908	509,733

Calumet & Hecla's net miscellaneous income—dividends from other companies, silver, etc., was $3,977,943.

Taxes were as under:

	Income tax, 1917	Excess profits tax, 1917
Calumet & Hecla	$409,189	$570,286
Ahmeek	112,999	869,761
Allouez	40,770	204,722
Centennial	4,384	.....
Isle Royale	53,242	133,377
La Salle	7,200	.....
Osceola	55,469	496,935
Superior	6,172	4,462
White Pine	16,961	17,307

Dividends: those paid in 1917 and to date are as under:

Company	1917	To end of 1917
Calumet & Hecla	$8,500,000	$145,250,000
Ahmeek	2,800,000	10,050,000
Allouez	1,050,000	2,300,000
Centennial	90,000	180,000
Isle Royale	600,000	1,575,000
Osceola	1,346,100	16,602,575
Superior	100,000	.....
White Pine (pfd. shares)	29,063	.....

Development: in the conglomerate section of the C. & H. new drifts were 2942 ft. long. Shaft-pillars and arches being removed employed 89 drills, yielding 505,682 tons. In the Osceola section there was 338 ft. of shaft-sinking done, also 16,352 ft. of new drifts. In the Ahmeek mine sinking amounted to 964 ft., also 16,085 ft. of other work. On No. 18 level of No. 2 shaft a storage-battery locomotive was installed. Others are to be used on No. 17, 19, and 20 levels of this shaft; No. 18 of No. 3, and No. 14, 15, 16, and 17 of No. 4. New openings in the Allouez amounted to 2838 ft. Ore exposed is of average quality. Five electric locomotives are working at No. 2 shaft. Including 244 ft. of sinking, Centennial development covered 1653 ft., mainly on No. 38 level north. Isle Royale did 996 ft. of sinking, also 19,271 ft. of other work from 7 shafts. La Salle sank No. 2 shaft 163 ft. to 2242 ft. depth. Other work totaled 2145 ft. Exploration by the Osceola company in La Salle ground was stopped in November owing to difficulties of operation. In the Osceola mine, development amounted to 6445 ft. in the three branches. Above No. 46 level and near the extreme south and west boundaries of the Osceola branch was the most productive ground. In the Superior there was 198 ft. of sinking and 2502 ft. of driving done. Reserves are estimated as 150,000 tons. White Pine sank No. 2 shaft 755 ft. to a depth of 1078 ft. Gray sandstone was cut at 800 and 900 ft., a better lode being disclosed on the latter level than on 800 ft. From No. 4 shaft 1000 ft. of drilling was done on No. 4 level, showing No. 2 lode to be fair and No. 3 poor.

Production:

Mine	Ore, tons	Copper lb. per ton	Yield, lb.	Cost per ton	Cost per lb., cents	Received per lb., cents
C. & H.	3,159,570	21.65	68,419,826*	$2.52	13.01	28.39
Ahmeek	1,271,275	22.00	27,919,812	1.74	9.42	26.84
Allouez	566,674	15.69	8,892,915	1.87	13.84	27.95
Centennial	148,332	13.50	2,002,857	2.33	18.67	26.96
Isle Royale	922,160	14.60	13,480,921	2.02	15.74	26.87
La Salle	185,014	10.38	1,919,775	1.87	20.14	28.45
Osceola	1,237,805	13.00	16,084,958	1.63	13.86	27.89
Superior	129,587	16.99	2,201,672	2.50	16.88	29.39
White Pine	212,889	19.11	4,067,529	2.37	14.99	28.30

*From mine only. In addition was 9,075,457 lb. recovered by the reclamation plant which pumped 730,543 tons of sand from Torch lake, classified it, re-ground the coarse material, and leached all by ammonia. This sand carried 17.06 lb. per ton, of which 12.42 lb. was saved at a cost of 5.94c. per lb., exclusive of smelting and selling.

Costs: on a per ton basis these rose 49c. at the C. & H., 28c. at Ahmeek, 19c. at Allouez, 41c. at Centennial, 49c. at Isle Royale, 8c. at La Salle, 27c. at Osceola, 43c. at Superior, and 29c. at White Pine.

HECLA MINING CO.

Property: mines at Burke and mill at Gem, Idaho.

Operating Official: James F. McCarthy, general manager.

Financial Statement: income from metals, etc., in 1917 totaled $3,671,818. Operating charges were $1,507,868, leaving $2,163,950 net.

Dividends: these amounted to $1,600,000, making $6,905,000 to date.

Development: this work covered 12,386 ft., including 210 ft. of sinking, and 3473 ft. in the Ore-Or-No-Go mine. The shaft is being sunk to 2000-ft. level. Ore-reserves are estimated as 1,326,399 tons.

Production: the last four years compare as follows:

	1917	1916	1915	1914
Ore mined, tons	374,213	250,559	146,675	123,875
Concentrate shipped, tons	30,334	.....	.....	.....
Crude ore shipped ,tons	14,474	.....	.....	.....
Zinc slime shipped, tons	709	.....	.....	.....
Total	45,517	40,832	26,214	20,052
Metal in ore:				
Lead, per cent	48.75	49.25	47.55	47.25
Silver, ounces	30.00	29.30	26.40	25.40
Zinc, per cent	7.65	.....	.....	.....
Lead produced, pounds	44,363,559	40,217,573	24,917,867	18,957,823
Silver produced, ounces	1,366,960	1,195,841	692,444	509,200
Zinc produced, pounds	507,888	.....	.....	.....

Costs: mining cost $2.5333; development, 35.4c.; sorting, 17.7c.; milling, etc., 68.6c.; and general, 42.9c., a total of $4.029 per ton.

WAIHI-PAEROA GOLD EXTRACTION CO.

Property: tailing claims on the Ohinemuri river, 20 miles below Waihi, New Zealand. Old tailing from mills in the mining districts is dredged from the river, ground in 22 tube-mills, and cyanided. One section has been dredged 30 times, being re-filled by floods.

Financial Statement: out of the profit of £10,529 ($49,000) made in 1917, £6250 ($29,800) was paid as a dividend.

Production: the plant treated 147,700 tons of slime (ground sand), yielding gold and silver valued at £52,479 ($254,000). In 1916 the output was $43,000 less. So far there has been treated 845,000 tons.

Book Reviews

Handbook of Engineering Mathematics. By Walter E. Wynne and William S. Spraragen. Pp. 220, ill., index. D. Van Nostrand Co., New York, 1917. For sale by 'Mining and Scientific Press.' Price, $2.

This is an engineer's handy volume, giving the elements of algebra, geometry, plane and spherical trigonometry, plane and solid analytic geometry, calculus, hyperbolic functions, differential equations, theoretical mechanics, mechanics of materials, hydraulics, flow of fluids, electricity, measurement, physical and chemical constants, together with tables of circles, powers, roots, reciprocals, common and natural logarithms, trigonometric functions, and hyperbolic sines and cosines. As an example of the treatment, we abstract the following:

"Torque

The torque of a dynamo in foot-pounds equals

$$T = KI\phi$$

where ϕ = total field flux in magnetic lines, cutting armature conductors,

I = armature in amperes.

K = constant terms for any given dynamo. Its value is

$$K = \frac{2\,3\,4\,8}{10^9}\ tP,$$

t being the number of armature turns in series, and P the total number of poles.

The torque of a motor in terms of the horse-power is

$$T = \frac{33{,}000\ \text{H.P.}}{2\pi n}$$

or solving for horse-power,

$$\text{H.P.} = \frac{2\pi Tn}{33{,}000} = \frac{2\pi RFn}{33{,}000}$$

n = number of revolutions per minute,

T = torque in foot-pounds,

R = radius of pulley in feet,

F = turning force in pounds."

Everyman's Chemistry: The Chemist's Point of View and his Recent Work Told for the Layman. By Ellwood Hendrick. Pp. 374, index, bibliography. Harper & Brothers, New York, 1917. For sale by 'Mining and Scientific Press.' Price, $2.

The popular scientific treatises by Mr. Hendrick are well known. They have been justly accepted by the public with the enthusiasm that the public always displays toward scientific subjects when presented clearly and brilliantly, couched in simple terms, and emanating from a person that can speak with authority. The book is thoroughly scientific in the sense that the development of the subject is along scientific lines. A man knowing no more chemistry than is contained in this book would have a very broad outlook upon the constitution of the world in which he lives, and he would better appreciate the complexities of modern industrial life and the needs of the Nation in stimulating and maintaining production of the many important essentials in War as it is conducted today. This is in no sense a war book, but its bearing upon the struggle should be very great, because it will help men who are not familiar with chemistry to obtain a grasp of the chemical bases of modern industrial life. The volume discusses air and water, the halogens, sulphur and its compounds, phosphorus, arsenic, antimony, bismuth, the alkali metals, sand and clay, lime and magnesia, iron and steel, and many metals both common and rare. With special facility the author undertakes to elucidate the principles of organic chemistry, starting with the carbon molecule and the simple hydrocarbon CH_4, from which he develops correctly the modifications that lead to the vastly complicated products of which there is no end. He promptly, however, comes to the practical application of organic chemistry in the discussion of olefins and acids, alcohol and some of its derivatives, fats, oils, sugar, starch, and gums. Cellulose and nitrogen compounds, the aromatic compounds, and the coal-tar derivatives constitute the remainder of the book, with the exception of some valuable appendices. In this discussion the author reveals the chemistry of the common things of life, such as industrial alcohol, soaps and their uses, cane and beet sugar, gums, varnishes, paints, bread-making, explosives, artificial silk, paper, benzol, picric acid and aromatics, and dyes. Any man with an ordinary high-school education will be able to read the book, and it is so delightfully written that it is a pleasure to read it. We would suggest that the technical men who happen to be identified with operations involving organic chemistry would find it a most useful and delightful means for reviewing the subject in the light of modern manufacture.

Mining Decisions

Mining Corporations—Posting Balance-Sheets

California Civil Code section 588, requiring all California mining corporations whose stocks are listed for sale on public exchanges to keep posted in their offices balance-sheets, duly verified and showing their correct financial condition, has been held to apply to California corporations organized for the purpose of conducting mining in another State.

Overton v. Noyes (California), 170 Pacific, 1110. February 5, 1918.

Mining Option—Notice of Non-Exercise

Where under a lease and option for the purchase of mineral lands it was provided that unless the lessee gave notice on or before a certain date that he would not exercise the option, he should be held to have exercised it. A letter written before that date announcing that he intends to give notice of non-purchase does not constitute notice, nor does a notice written a week after the expiration of the date avail the lessee anything. He was held bound to pay the purchase-price in a suit for specific performance.

Mackey Wall Plaster Co. v. United States Gypsum Co. (Montana), 244 Federal, 275.

Mining Partnership—What Constitutes

Two miners bonded their claim to a third, who interested two other persons in the development of the claim under an agreement to convey them each a third if the option should be taken up, and to personally take charge of the management, control and operation of the mine, they to take care of the payments on the bond and expenses of operation, etc. The working party to the agreement continued operations for a number of years during which the other two advanced the payments under the bond and enabled him to acquire title in his own name. Subsequently he was compelled to mortgage the claim for expenses and advanced considerable sums himself for development and assessment work, on all of which indebtedness he was refused reimbursement by the other two. Held, that a complaint setting up the above facts, seeking to hold the other two for an accounting as partners in the transaction and to have the working partner declared a trustee for them as to a two-thirds interest in the mine, stated a cause of action, and the demurrer thereto was improperly sustained. It is not essential that all mining partners should actually engage in physical work on the claim. It is sufficient to constitute a mining partnership under Section 2511, Civil Code, if one or more works and the rest merely furnish the money.

Harper v. Sloan (California), 169 Pacific, 1043.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

A PERFECTED CALCULATOR FOR ENGINEERS

The pencil method of figuring problems is rapidly becoming extinct. The up-to-date mining company can no longer afford to have its engineers and accountants spend time in unnecessary hand figuring when machine calculation has been perfected as in the Marchant calculator.

This device was first placed on the market in 1911 and



PHOTO. OF THE MARCHANT CALCULATOR

its success has been such that today it is sold not only throughout the United States but also in 18 foreign countries. Two models are built—the standard size designed for office use, and the 'Pony.' The latter is a light portable machine weighing but 12 lb., measuring only 8 by 12 inches. It has been designed especially for the engineer who wishes to take it with him in the field.

Typical problems which the Marchant calculator will handle in a fraction of the time required by the ordinary pencil method, are given below:

Distribution of Metals

6948.82 tons ore assays as follows:
0.129 oz. gold per ton
5.72 oz. silver per ton
3.225% copper

Weights

$6948.82 \times 0.129 = 896.398$ oz. gold
$6948.82 \times 5.72 = 39747.250$ oz. silver
3.225% of 2000 lb. = 64.5 lb. per ton
6948.82×64.5 lb. = 448198.89 lb. copper

Value

$896.398 \times 20.6718 = \$18530.16$
$39747.25 \times 689 = \$27385.86$
$448198.89 \times 0.155 = \$69470.83$

The time required for this entire calculation is one minute.

To Determine Value of Gold Return

156.245 oz. gold = $3229.87
364.733 oz. gold = $7539.69
168.464 oz. gold = $3482.45
1356.064 oz. gold = $28032.28

The rate of $20.6718 is set on the calculator, and all the extensions are made in 40 seconds without once clearing the machine.

Surveying Calculations—Traverse

Bearing 34°36′ E; distance 295.76
Nat. co-sine 0.82314; sine 0.56784
$0.82314 \times 295.76 = 243.452$ northing
$0.56784 \times 295.76 = 167.944$ easting

The time consumed when using the Marchant calculator is 25 seconds.

In the new Pony Marchant special machine all of the factors of a calculation are visible to the operator and may be easily checked. The new register dial, which makes this possible, is a late improvement and is a special feature of the Marchant. For instance: in performing a multiplication such as 91.65×22.16; first set 9165 on the levers. As this is done the top register dial checks the work and records the amount set up. The left-hand dial records every turn of the handle. The result, namely, 2030.964, shows in the right-hand dial.

The Utah Copper Co. sums up the use of the Marchant in this way: "The machine proved itself so valuable in making up our cost statements, and in verifying ore settlements that we purchased five more Marchants. These are used by our engineers in all calculations pertaining to tonnages, averages, assays, and percentages."

Other users are the Utah Iron & Steel Co., the American Smelting & Refining Co., the International Smelting Co., Ray Consolidated Copper Co., and the Chino Copper Co. Descriptive literature and further information can be obtained by addressing the Marchant Calculating Machine Co., Dept. P, Emeryville, Oakland, California.

PRICES OF FLOTATION OILS

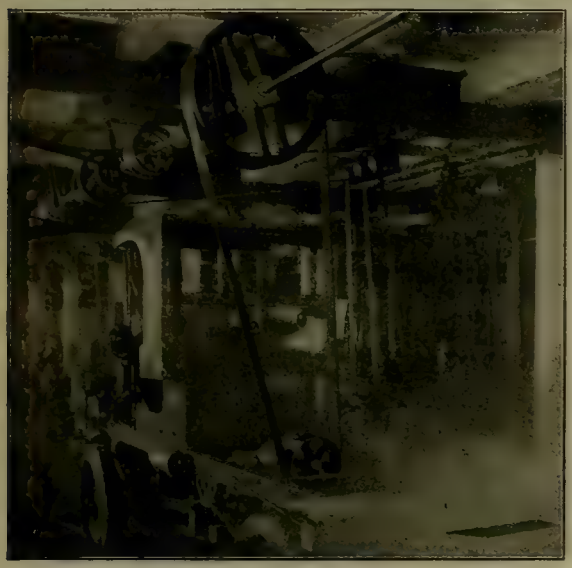
The latest published quotations on distilled pine products for use in flotation, as given by the Pensacola Tar & Turpentine Co. is as follows, the prices being in cents per gallon:

	Oil No.							
	350	80	75	750	40	200	400	100
In your tank cars..	27	36	36	24½	..	28	29	45
In our tank cars..	29	38	38	26½	..	30	31	47
In wood barrels....	34	45	45	31½	50	35	36	54
In steel drums.....	42	51	51	39½	57	43	44	60
In cases	45	54	54	42½	60	46	47	63

Note: Drums are 18-gauge black steel having about 52 to 55 gal. capacity; the cases contain two 5-gal. cans each; and the wood barrels used are the best available for the types of oils supplied. The barrels for the lighter oils cost over $4 each and are sized with two coats of best glue.

FACTORY OPERATED BY DUPLEX TRUCKS

A Duplex 4-wheel drive truck has again substantiated its manufacturers' claim that the Duplex is equal to any emergency, when a truck supplied power in one of the factory's departments, which otherwise would have been forced to close. When the flood-waters of the Grand river made impossible the operation of the Michigan Power Co.'s plant in Lansing, among the scores of factories affected was that of



TRUCK-DRIVING A TOOL-ROOM

the Duplex Truck Co. However, it was not necessary to close the Duplex tool-room because of a novel arrangement whereby power was furnished by a Duplex 4-wheel drive truck. A pulley wheel was attached to the rear of the chain-case shaft of the truck, and a belt transmitted the power to the line-shaft above. The Duplex supplied ample power to operate all the machinery in the tool-room.

COMMERCIAL PARAGRAPHS

The Colorado Iron Works Co. announces the removal of its Eastern office to 30 Church street, New York.

'Revista Minera', published by Mark Lamb at 30 Church street, New York, gives considerable information on the present status of tin production in the last issue, dated April 22.

The General Engineering Company whose head office is Salt Lake City has opened a branch office at Room 2817, 120 Broadway, New York, under the charge of E. B. Thornhill, who still retains the management of the Canadian office at 363 Sparks street, Ottawa.

Zelnicker's Bulletin, No. 241, issued April 29, 1918, quotes on second-hand rails of both light and heavy sections, as well as on box, flat, and gondola cars, and various locomotives, including Shay geared locomotives for standard gauge track, light rod engines for 3-ft. gauge.

At the safety-device department of the State Industrial Accident Commission, Market street, San Francisco, the Yuba Manufacturing Co. of Marysville, California, has in operation a complete model of its No. 14 dredge, which is working on the Yuba river. The model weighs 1200 lb., and in every respect represents the 2000-ton, 16 cu. ft. dredge, one of the largest in the world, digging to a depth of 70 ft. below water. This model was shown in the Mines building of the Panama-Pacific Exposition during 1915.

Broderick & Bascom Rope Co. of St. Louis, Missouri, has issued The Yellow Strand Joke Book, giving wholesome humor to relieve the tension of engineering work, the suggestion of which follows the jesting page by page with representation of the application of the Broderick & Bascom products in the constructive operations of the age.

The Wheeler Condenser & Engineering Co., of Carteret, New Jersey, has issued a fourth edition of its useful little handbook of Steam Tables for Condenser Work. It embraces properties of saturated steam from 29.8 in. vacuum to atmospheric pressure; properties of saturated steam from 32° F. to 212° F., and the same from zero gauge pressure to 200 lb.; together with corrections for thermal expansion of mercury, for relative thermal expansion of mercury and the brass scale, and for standard gravity and capillarity. Examples are given to guide in the use of the tables.

The Link-Belt Co. has issued a handsome pamphlet on Link-Belt Silent Chain, the Efficient Drive for Machine Tools. This is book No. 312 of the publications of this company. This chain-drive is guaranteed to give an efficiency in transmission of 98%. An instance is cited where a 5-hp. motor was found to be sufficient after installing the silent chain-drive in place of a 7½ hp. motor that had previously been required. The manufacturer said, "The old method of drive with two sets of gears and two sets of bearings, a shaft and two pulleys and belts, must have taken at least 30% of the power delivered by the motors."

A book of 144 pages, elaborately illustrated, dealing with questions of maintenance of plant so far as repairs are concerned in which cements are applicable, in the cases of breaks in pipes and castings that cause leaking of steam, water, or oil, will be sent free to anyone making application to the Smooth-On Manufacturing Co. at Jersey City, New Jersey. The book will prove of value to any engineer as a guide to the efficient use of various kinds of cements in keeping his plant in good condition, free from leaks and slop, and delivering the steam or air without loss to the point where it is to be utilized. The book gives instructions in repair-work of the kind mentioned, and details for making non-leak 'smooth-on' joints, for insuring tight joints in structural iron or steel work, filling rivet heads, for waterproofing and stopping leaks in concrete or brickwork, and the adaptation of the 'smooth-on' coated corrugated gaskets for withstanding high temperatures and pressures.

Mistakes.—When the credit man makes a mistake, it is 'good night.' But when the plumber makes a mistake, he charges twice for it; when the lawyer makes a mistake, it's just what he wanted, because he has a chance to try the case again; when the carpenter makes a mistake, it's just what he expected, because the chances are 10 to 1 he never learned his trade; when a doctor makes a mistake, he buries it; when a judge makes a mistake, it becomes the law of the land; when a preacher makes a mistake, nobody knows the difference; and when an electrician makes a mistake, he blames it on induction, the meaning of which nobody knows. 'Pittsburgh Credit Bulletin.'

The Board of Labor at the Mare Island Navy Yard announces that there are wanted immediately 100 unskilled laborers at $3.60 per diem, and an unlimited number of machinists at $5.84 per diem for satisfactory mechanics. Information may be obtained from the Secretary of the 12th Civil Service District, Postoffice Bdg., San Francisco, California.

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By E. H. Wedekind 745

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Ingenious device by S. Paul Lindau and W. S. Evans; comparison of gain at different costs of fuel by using this dryer. M. & S. P., June 1, 1918.

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SOME FIGURES ON THE MARCY INSTALLATION

AT THE NEW PLANT OF THE ENGELS COPPER CO.



New Mill of The Engels Copper Co.

June 1917, The Engels Copper Company purchased a No. 86 Marcy Mill for their new plant. Operation of the plant was started about the middle of March, 1918.

The Marcy Mill is taking the product from No. 5 Gyratory crushers, after it has passed over a 1-inch grizzly. The Marcy Mill gets all of the coarse feed. *Note that point.*

Feed to Marcy Mill:

All through 4½-inch ring.
25% on 3-inch ring.
25% on 2-inch ring.
50% on 1-inch ring.

The ore is very hard and tough. At the present time the Marcy tonnage rate is in excess of 400 tons a day when grinding in closed circuit (about 90% of the 24 hours) finishing 95% through 100 mesh. The balance of the time the Marcy grinds in open circuit for tube-mill feed, and shows much higher tonnage rate.

The indications are that this tonnage will, in a short time, be materially increased.

The performance of the ball-mill crushing equipment at this plant is worthy of investigation.

Bulletin No. 42 gives many interesting facts concerning the Marcy Mill—"One Easy Step." Write for a copy.



Headquarters for Mine, Mill and Smelter Equipment, Wilfley Tables, Assay and Electrical Equipment and Supplies.

THE MINE AND SMELTER SUPPLY COMPANY

A SERVICE STATION WITHIN REACH OF YOU

DENVER SALT LAKE CITY EL PASO

New York Office: 42 Broadway



RUMOR is current at Washington that one of the early bureaucratic changes likely to be made by the President under the authority of the Overman Act for re-distribution of departmental functions will affect the status of the Geological Survey and the Bureau of Mines. It is thought that consolidation of these bureaus under a single executive head may be effected, the activities of the staff then being limited to war work exclusively.

COMPULSORY subscription to war-loans has been ordered by the government of New Zealand. This is the first instance of the kind among the Allies during the pending conflict. Only those persons whose taxable income exceeds £700 are affected, and they are required to subscribe an amount equal to three times the total land and income tax, exclusive of excess profits contributions, which they are obliged to pay under the Finance Act of 1916.

CHROME ore occasionally enters the port of San Francisco from Australia and the South Seas. In April the arrivals amounted to 1000 tons. During the month of May 1500 tons was received, and as much more is due. It comes in the form of ballast with cargoes of wool, chiefly from Melbourne. The quantity available in this manner, however, is so small as to exert no effect upon the market price, nor does it lessen the need of strenuous efforts to produce from domestic mines.

WITHIN the last three weeks $30,000,000 worth of silver certificates has been withdrawn from circulation, as the coin which secured them was melted into bullion under the new Silver Act. They are to be replaced by Federal Reserve banknotes of $1 and $2 denominations, constituting the first war-currency that has been issued up to the present time. The face of the $1 note will carry the portrait of George Washington and the $2 note will be distinguished by the portrait of Thomas Jefferson.

A principle that may serve as a useful model in connection with future regulations concerning restricted imports was applied by the War Trade Board on May 8 with regard to rubber. The amount that may be brought to the United States is limited to 100,000 tons per annum, but profiteering is prevented by fixing the price of the crude article from the time of importation until it passes into the hands of the manufacturer. It may be remarked that rubber is one of the few materials that has not advanced in value during the War. The price established by the Government is practically that which was ruling in the market, being only 68 cents per pound for the highest grade. This is about one-third the market value fifteen years ago.

SOME time ago the Navy Department issued a call for the loan of field-glasses to aid our sailors in detecting submarines. The Department now confronts a shortage of sextants, chronometers, and aneroids, and a similar appeal is made to the people for a fresh display of interest in the work of war by offering instruments of this kind to the Government. They will be tagged for identification so that, if they come safely through the conflict, they will be returned to their owners. Contributions may be sent directly to the Navy Department at Washington, or to the branch Hydrographic Office in the Merchants Exchange building, San Francisco.

MEXICO'S attempt to dip into our gold reserve, by requiring exporters of silver to re-import half its value in the form of gold bullion, has come to naught. When only 25% of the value of the silver was made returnable in gold the American Smelting & Refining Company needed about $500,000 worth monthly for the purpose. Carranza saw his chance to get a round million. He tried to bluff us by an implied threat to destroy the smelting company's business, but the Federal Reserve Board refused to supply the gold, and the obnoxious order was recalled. To pay gold for silver is contrary to time-honored custom in this country, and we strain a point in letting Mexico have even 25% of the value of the imported silver in the form of the yellow metal.

ON May 21 the President signed the so-called Sedition Act, which is primarily directed toward the suppression of hostile criticism of the Government by enemy aliens and sympathizers with Germany. It is a measure adequate for the purpose and is sweeping in its restrictions upon free speech, in so far as strictures upon the authorities may indicate a purpose to hamper the conduct of the War. There are two kinds of criticism, destructive and constructive. The first is exceedingly easy and is usually invidious, but constructive criticism requires understanding and is helpful. Not only does this remain open to all men possessed of sufficient capability to give it, but it will be welcome. Whoever can contribute in

this useful manner to the welfare of the country is one that also will know how to do it without descending to aspersions upon those who are struggling to save our national heritage from the ruthless Hun.

ATTENTION was called recently to the interesting fact that Argentina established a credit of $40,000,000 with the Federal Reserve Bank in the United States, to be accumulated by deposits to this account by importers as a means of covering the balances due on goods brought from that country. This was equivalent to an advance of gold, since otherwise it would have been necessary to export an equal amount. Against this credit the Argentine government has issued paper currency, thereby utilizing the trade balance as a means for improving financial conditions at home. The plan has proved so satisfactory that arrangements have been made for increasing the credit to $80,000,000. It also has encouraged Peru to avail herself of the same advantages in the promotion of more active trade with the United States. The amount of the first Peruvian credit will be $20,000,000. Such relations tend to cement the interests of the countries concerned, and to cultivate friendly feeling.

LAST week we published a vigorous opinion on the Government's plans for accelerating the output of the rarer minerals written by the kind of man from whom the officials at Washington are eager to hear. We refer to the article in our discussion columns on the treatment of tungsten ores by Mr. J. H. Ratcliffe. He is not only a producer, but he represents the hard-headed hard-fisted type that works in his own mine and mill with his own hands. This is the class of man the Government chiefly must rely upon for the augmented supply of manganese, chrome, tungsten, and other materials specified in the War Minerals Bill. His statement that the miners merely require a fair price fixed definitely for a reasonable period, so that they may plunge into the work without danger of becoming financially swamped, sustains the argument we have presented from time to time, and shows that Mr. Pope Yeatman was a well-informed counsellor when he urged the Senate Committee on Mines to re-instate the price-fixing authority in the bill, which the House unwisely had excised.

SOCIAL aspects of industry increasingly engage the attention of mining engineers. The War and its impact upon society have brought into prominence the human side of the fundamental relations between capital and labor. We take pleasure therefore in printing an address delivered recently at Boston by Mr. J. Parke Channing, a member of the profession distinguished for his enlightened interest in this vital subject. Mr. Channing speaks not only as an experienced consultant and engineer of mines but as an employer of labor on a big scale. It is a keen pleasure to note the emphasis he places on the need for assimilating our foreign labor elements, for Americanizing the alien masses that perform so large a part of the spade-work of the mining industry. Undoubtedly this melting-pot of ours will fail in its social and political metallurgy unless its operations are supervised and directed in a consciously intelligent way by those sufficiently far-seeing to appreciate its great import to the future of this nation—a nation composed of ethnic fragments broken from Europe. 'Human engineering, is a subject that should appeal to earnest educated men, of the type represented by graduates from our mining colleges, especially those that by skill and good fortune have advanced to positions of influence in the mining world. Among the many ways of furthering this splendid purpose of Americanization is to co-operate with the Y. M. C. A., as Mr. Channing has done at Miami, by establishing quarters where the foreigner is given opportunities to learn English, to obtain technical instruction, and to engage in healthy athletics, all of these tending to promote an understanding of America and the American ideal, that ideal being to give every man a chance.

Re-Sale Prices

One of the developments of modern intensive commercialism has been the obligation placed upon buyers of manufactured articles to re-sell at prices fixed by the original producer. It has been one of the cardinal points in the system of trade proprieties recognized as a sort of ethical code among business men. This dictum of the manufacturer follows a trade-mark as well as a patent-brand from the shop at Pittsburgh, Chicago, or San Francisco to the miner at Grass Valley, Cottonwood Canyon, or Miami. It makes the drill-steel, the shovel, the mine-car, cost more than it might, because underselling has been prevented. It is not surprising that these practices should soon have commanded the attention of the courts and of the Federal Trade Commission, since they involve the principle of restraint of trade. Suppression of such restraint has become, in the opinion of trade organizations, which express the views of aggressive business, an irritating fad, while the people have seen in the growth of the practice a tendency to evade in subtle ways the fundamental ideals of natural trade, so jealously safeguarded in the Constitution. As a problem in political science this is one of the most vital that has come before the country in these later years. Recent decisions have now declared the practice of fixing prices for re-sale to be illegal. The decisions are broad and unequivocal. Whatever one may think regarding the matter, or however defensible may seem his contrary argument, no doubt remains as to the case-law that now has added its sanction to the statutes. Open competition henceforth is required; the trinity of 'trade-mark, quality, and price' must hereafter give place to the duality of 'brand and quality' alone. This should benefit the 'brand of quality' after all, for, if the retail price can be clipped, the 'just as good' will be more surely passed by in favor of the article with the trade-mark emblematic of superior excellence. This but accentuates the element of effectiveness in the well-known economic principle of comparative advantage.

The wide inclusiveness of the new ruling appears from the decision of the Supreme Court last March on the injunction issued by the lower courts restraining the Boston Store of Chicago from selling talking-machine records at less than the authorized price in violation of a contract with the American Graphophone Company. The Court affirmed its right of jurisdiction under the patent laws, and then answered with a flat negative the question "Can a patentee, in connection with the act of delivering his patented article to another for a gross consideration then received, lawfully reserve by contract a part of his monopoly right to sell?" In line with this, but giving it a far broader scope, is the formal finding of the Federal Trade Commission in the case of Chester Kent & Company, proprietary medicine manufacturers of Boston. Reference is made by the Commission to the need of an interpretation of the law to settle the controversy in progress throughout the country over the right of manufacturers, wholesalers, and others, to fix re-sale prices for articles after passing from their hands in the general course of commerce. The case was clearly taken to have the significance of a test, and the order issued held the following: the seller is prohibited from indicating to dealers the prices for which the commodities sold, whether patented or not, may be re-sold; the seller is forbidden to secure from dealers any agreement to adhere to fixed prices; moreover it is unlawful to refuse to sell to dealers who fail to adhere to such re-sale prices, or to refuse to sell to such parties upon the same terms as to other dealers who may elect to observe the restrictions; and finally it is forbidden to furnish any advantage to dealers who are willing to observe the wishes of the seller as to an official fixed price. It is suggested by Justice Brandeis that the only remedy may be found in Congressional action, but it will be extremely difficult to cover the case by an act that will stand the constitutional test. The law of the land now is: One price to all, no left-handed favoritism allowed, and a thing once sold becomes the absolute property of the buyer, to do with as he likes.

Flotation Physics

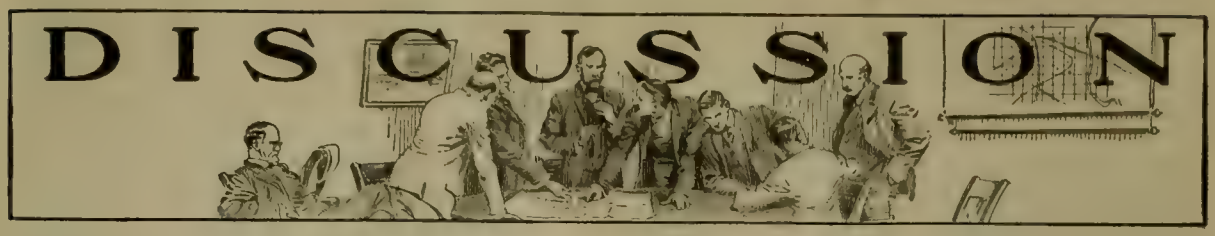
We publish a suggestive article on a phase of flotation by Mr. W. H. Coghill, to whom we have been indebted for several useful contributions to the science of the subject. He addressed the local section of the Institute in San Francisco early in April and on that occasion discussed the contact-angle of water on glass, with sundry of its applications to flotation. A glass boat, 60 by 140 millimetres, floating on water and carrying small weights, such as two corks and a pencil, served as the exhibit on which he lectured. Along the edge of this glass plate a groove had been cut to a re-entrant angle of 60 degrees, which is the contact-angle of water on glass. A similar disc of window-glass 77 millimetres in diameter floated with a load of 10 grammes of sand. The glass lay in a depression three millimetres deep and displaced a weight of water equal to 25 grammes, this being the head or pressure that stabilized the floating. The phenomenon is that of surface-tension, which varies with different liquids, as we all know. Given the surface-tension and the specific gravity of a liquid, its contact-angle can be ascertained by a curve established by Mr. Carl O. Anderson, who has co-operated with Mr. Coghill in his research at the Seattle station of the U. S. Bureau of Mines. A drop of water has a maximum height of 5.4 mm. More water does not increase the height of the drop, but advances the edge; and when the water reaches the edge of a glass plate, for example, its height increases before it breaks. The maximum height of 5.4 mm. is reached when the edge of the plate has an angle equal to that of the advancing water, namely, 60 degrees. From this it is deduced that the most floatable substance, on ordinary water, is one having a re-entrant angle of 60°; also that the larger the angle of contact, the better it floats. It is possible that the separation made in the flotation-cell between sundry metallic minerals is dependent upon their systems of crystallization and the character of their fracture. Mr. Coghill also exhibited charts showing the action of various oils, which are divisible into those that reduce the surface-tension to less than 62 dynes when present in the proportion of 0.1%, and those that reduce the surface-tension to less than 65 dynes under the same conditions. The maximum effect was to reduce the surface-tension to less than 45 dynes. Here he explained the drop-weight method for testing oils, as outlined in the article we publish this week. When insoluble oils are used their effect must be due to emulsification. The accumulation of oil at the surface of a flotation-cell, after it has been in operation for some time, is proof of this deduction. At this meeting, mention was made of the experiment by Mr. A. F. Taggart to prove the greater floatability of unoiled aluminum as compared with the oiled metal. We referred to this at the time when it was published and expressed regret that the publication of it in a bulletin of the Institute did not provoke discussion. The experiment was made with a heavy oil, namely, oleic acid, and that may explain the failure on the part of others to duplicate the results obtained by Mr. Taggart. Moreover, there is this to be said: aluminum is non-corrosive largely because it is promptly covered by a thin film of oxide, which gives it a surface of non-metallic lustre. That may be why it behaved so queerly in Mr. Taggart's experiment. Assayers will recall the fact that milligramme weights, which are made of aluminum, are allowed to season for a year in order to stabilize them; likewise the lead used for sheathing vats in acid-works becomes coated with sulphate, whereby further solvent action is checked. In any event, it is incumbent upon specialists to investigate the matter, which otherwise is so subversive of even the most elementary notions on the subject. Writers on flotation may have placed too much stress on surface-tension in 1915 and 1916, and we do believe now that viscosity plays an important part, but surface-tension, particularly in its variability, remains a fundamental factor. Floatability may be regarded as depending on the area of surface around the edges of which the three

phases—air, liquid, and solid—meet. Flaky minerals float because they present a large area of face in relation to their mass. The reduction of the angle of contact at the interface is another point. Time is an element of viscosity, and non-frothing oils increase such viscosity. The mineral particles subjected to flotation in the mill are mostly so much larger than colloidal particles that we cannot fall back on this interpretation for the principal phenomena. In the end flotation is the result of the forces of cohesion and adhesion pulling against gravity. The modifying agents are many and new ones are being discovered every day. There lies the hope of further development in mill-work. Meanwhile we hazard a definition of the flotation process in terms of our present knowledge.

Flotation is a process in which a multitude of bubbles, developed in a pulp of ore, is utilized as a means for separating valuable minerals from the valueless gangue. This separation is based on the fact that sundry minerals (especially sulphides) exhibit a preference for air-bubbles when these are made in a liquid modified for the purpose by the addition of a substance that produces a variable surface-tension. The bubbles result from the dispersion of air in the pulp, whether entrained by agitation or blown through the porous bottom of the vessel in which the operation is conducted. These bubbles rise, and the variable surface-tension produced by the modifying agent added to the water hinders the coalescence of the bubbles while they are rising. The modifying agent may be a constituent of various oils or it may be any one of many other substances, including alkaline chlorides; it enters into the bubble-films between water and air, where the mineral particles are caught and held at the interface. The mineral-laden bubbles, arriving at the surface, aggregate into a froth, which is withdrawn, to be collected as a concentrate; this is drained, filtered, and dried previous to reduction by smelting in the ordinary way.

Is Turkey Disillusioned?

Altogether the most significant Mittel-European political news that has come in months was contained in a dispatch from Paris announcing an outburst of indignation in Turkey against her Teutonic exploiters. Had this dispatch come from Amsterdam or from Berne we would be disposed to consider it 'made in Germany' for foreign consumption, but it has filtered through France, and it bears the marks of intelligent comprehension of the Near Eastern question, such as may be found in official Paris. The young Turks are said to be conducting a bitter campaign in the press against Bulgaria, coupled with well-founded charges that Turkey was be trayed by the Central Powers in favor of their Balkan ally. Turkey sees no increase in her European prestige after having made heavy sacrifices, while Bulgarian aggrandizement has been carefully arranged by the Bucharest treaty of peace. Bulgaria is the potential friend of any Christian State, while Turkey is a friendless mongrel Moslem, of whose alliance no respectable country could fail to be ashamed. Therefore Germany considers that Bulgaria has her price, which must be paid, while she may risk the Turk's willingness to remain in the fold as a last hope against the extinction that he deserves. In this Germany may be mistaken. The old line of autocratic sultans understood the weakness of their political position better than the young Turks, who consider themselves progressives and therefore worthy of friendly support from countries committed to democratic ideals. The Turkish coin of democratic reform possesses only feeble resemblance to the real article; it is of exceedingly low fineness and is clumsily executed. Nevertheless, we cannot afford to neglect the opportunity to encourage the exasperation of the Turk against the Teuton, and it may be shown that his best chance for survival is found in the fact that the Allies are squarely on record against annexations, except in so far as they may be driven to complete occupation and administration of territory as an essential for winning the War. Old Abdul Hamid would have seen a less hopeful sign in the heavens than the star and crescent when the lower Euphrates valley fell into the hands of hostile powers. His forbears realized that no Eastern empire long endured that failed to hold the two extremes of Asia Minor. This is the tradition of Oriental autocracy, and the historic fact is likely to be recognized by the new Turkey. The power of Turkey lay in that strong position, but now she has lost her whip over European diplomacy, and Germany never will be able to re-conquer it. Even if she could she would not do it for Turkey, as recent events in the Balkans have demonstrated. It is certain that Turkey has a just grievance against Germany at this time; consequently the report from Paris is so plausible as to be regarded as a hopeful indication of the possibility of disrupting the Central European wall at the Bosphorus by means of skilful diplomacy. It would be interesting if President Wilson's refusal to declare war on Turkey should lead to this result. Fortunately for us the blundering Von Bernstorff is now the German ambassador to the Porte, and his record in Washington was one of such conscienceless duplicity that an Oriental more than any other would disbelieve his fair promises. We saw no symptom of a defection of Austria at the time when Count Czernin was making enigmatic peace proposals, because the political and financial circumstances of this wreck of the Imperium Romanum meant that the last chance of the ruling house lay in following the fortunes of the Hohenzollern. If Austria were detached, a group of new nations would emerge. The case of Turkey is different. She can save what is left, and be better assured of retaining it under a reformed administration, by cutting loose from Germany, and submitting her destiny to the progressive nations that are dedicated to the cause of civilization. Germany now has nothing in hand to offer her in trade without stirring the ire of Bulgaria. The chance for self-preservation and for commercial advantage through accepting peace with the Allies may prove strong enough to encourage a break with the Central Powers.



Pyrite From California

The Editor:

Sir—The writer has read the articles and editorial comments in the MINING AND SCIENTIFIC PRESS during the past few months with much interest, and the present discussion is based on the hope of creating a market not for any ores that I may control, but for the requirements and demand incident to manufacturers of war material and to increase the loading and forwarding equipment. I do not exactly agree with you that ships cannot be had from the U. S. Shipping Board. All the industries of the Pacific Coast must largely get the material from the East for fabricating into completed products. This material consists of plates, shapes, bars, and the like made at rolling-mills and furnaces in the East. The food products of the West are almost entirely shipped East by rail. One of the chief manufactures of the West consists of ships; these must have ballast. California does not produce sufficient tonnage to furnish such dead weight for ballast. Ores will supply the lacking tonnage. It is doubtful whether sufficient cars can be had to move the large tonnages of ore available, should the Eastern acid-makers accept what I maintain can be offered, namely, 30,000 tons monthly. That would require 500 cars per month, or 17 to 20 per day. An attempt must and no doubt soon will be made to relieve the demands the railways are staggering under, in their efforts to deliver heavy freights by means of ships, especially when delivery will be made to the consumer directly.

E. H. WEDEKIND.

Reno, Nevada, May 5.

Improvised Flotation Dryer

The Editor:

Sir—With reference to the interesting article appearing in your issue of May 11 on an 'Improved Flotation Dryer,' by S. Paul Lindau and W. S. Evans, permit me to say that this ingenious application of an old pan-conveyor has undoubtedly provided an excellent temporary solution for a pressing problem. Only those who have tried it know the difficulties encountered in drying flotation concentrate or like materials that are apt to be a sticky colloidal pulp. There are plants in the district mentioned where flotation concentrate is dried in shallow vats with steam coils where the cost of fuel per ton of concentrate much exceeds $1, to say nothing of the additional cost for charging and discharging. Since it may be of interest to some of your readers, I am submitting a brief statement for comparison, with the cost of fuel $1 per ton of concentrate, as stated by you in the subject of this discussion, and the cost of fuel at several installations using the Lowden patent dryer, as follows:

One plant is drying 56 tons (dry weight) of concentrate per 24 hours, having from 15 to 16% moisture in feed to 4% in the product, with 3½ tons of coal at $4.25 per ton, or 26c. per ton of concentrate.

Another plant is drying 30 tons (dry weight) of concentrate per 24 hours, with from 15 to 16% moisture in the feed to 5% in the product, with 1¾ tons of coal at $4 per ton, or 23c. per ton of concentrate.

Still another plant is drying 31 tons (dry weight) per 24 hours of sticky colloidal concentrate, from 29% moisture in the feed to 13% in the product, with two tons of coal.

While the cost in the case of the Lowden dryer is given for coal, fuel-oil can be used. The choice of fuel would depend on the relative cost at the place of installation.

OSCAR REYNOLDS.

Denver, Colorado, May 17.

The Komspelter Indians and the Mexican Mining Law

The Editor:

Sir—Though I find little to criticize in your graphic account of the new developments of the Komspelter district, that little seems worth doing, as it seems to deal with something that is vital to the mining industry. It is perhaps as well for the Indians, as you state in your issue of March 2, "to take advantage of the opportunity given to them * * * by the U. S. government" as it would be for anyone else, but I refuse to consider that "a bountiful providence" can be a partner to this foolish transaction, or that "the energy of the white miner," who permits it to take place, can be considered "intelligent." Is not the catastrophe of the Great War a fitting time for us miners to take stock of the distributive as well as the productive side of our basic industry? How can an unearned 'royalty' paid to private individuals for permission to extract a living from raw mineral deposits be anything but a gross immorality, whatever may be the excuses mouthed by cunning pettifoggers to defend it? As students we were told that rewards in business are proportional to the industrial merit of the recipients, but your true story of the useless mucker, Hiram McBee, who gains more in a month from marriage to a land-owner than the cleverest mining engineer could usually hope to earn by a year's work, upsets the

romances of our school-days, and brings us face to face with anachronistic realities.

Politically considered, our laws regulating the ownership of mineral deposits are in direct conflict with the ideal of our institutions, which prescribes equal legal treatment to all citizens, because these deposits, being limited in quantity, can be given gratis to a few first-comers only by doing a gross injustice to the balance of the nation which is thereby deprived of its property rights in a national mineral resource. The favoritism is still more accentuated by the fact that a few mines only are very rich, and their owners are consequently more privileged by law than mine-owners as a class. It may be pleasant for the Commerce company to get $5,000,000, and for P. N. Moore to gain $500,000, also for various other speculators and Indian braves or squaws to be gathering up bushels of easy money without personal effort, but we may and must scrutinize the source of such windfalls, if we are expecting to do our duty by our generation and to make democracy safe for the world.

Before going further I beg leave to state the following economic axiom: 1. The value of mineral in the ground can be estimated by subtracting the cost of the labor and capital required for its extraction and marketing from its gross selling-price. 2. The cash value of an explored mineral deposit can be calculated by taking the present worth of its gross tonnage after assuming an average selling-price during the number of years required for total exhaustion. 3. Labor and true capital, that is, labor-products like tunnels, shafts, buildings, machinery, are active and competitive factors in production. Land (natural resources), constituting the remaining or third factor in production, is passive, and, being limited in quantity, is the monopolistic factor that tends to absorb the whole residuum of the wealth produced after the competitive returns of labor and capital have been paid.

For clear thinking, then, we must distinguish sharply between capital and land. In many districts, the relation of land to capital is complex. What part of a mine's earnings can be considered land rent (royalty) and what part interest on capital? In the Komspelter region, he who runs may read. Ben Quapaw never saved his pennies, as recommended by a leading Baptist, and yet he enjoys the income from four million dollars of savings, at 6% interest. Jim Good Eagle never worked an hour longer than the scheduled work-day—a popular recipe for getting wealthy—in fact, he probably never did a day's work in his life, and yet he is sporting a six-cylinder car; while Harry Crawfish and Julia Greenback did not miss success by anything more blame-worthy than failure to enroll themselves soon enough in the Federal agent's school for Indians who wish to get rich without working or saving.

Your criticism of the Mexican mining law, in your editorial of February 9, 1918, had some basis in its exposure of German intrigue, but I cannot agree with its strictures on Mexican land law as compared with ours. Under the former constitution of 1857, and the codes of 1884-1910, all metallic minerals were reserved to the Nation, while the constitution of 1917 reserves in addition all non-metallic minerals. The metallic minerals can now be exploited only by individuals who have acquired a lease-title and pay an annual rent for their holdings, this rent being graduated according to area and varying from $3 U. S. gold for claims under 10 hectares (25 acres) to $12 for the excess area above 100 hectares. The annual rent on petroleum lands was fixed this spring at $2.50 U. S. Cy. per hectare.

The effect of this stiff areal taxation is not to favor the rich, but rather to give the middle-class operator a chance, as the new rates are tending to break up the great speculative holdings that covered all the likely mineral ground in the country at the fall of Diaz in 1911. It is the middle-class man, not the peon, that must start mines here in this generation. The peon has not the initiative, the knowledge, nor the money to open a mine, no matter how low the areal tax might be reduced. Shame rather than undue modesty prevents me from claiming any responsibility for the new constitution, because it exhibits in so many places a deplorable lack of a consistent social philosophy, and yet I had probably much more to do with the creation of the famous Article 27 than had Lincoln Steffens, whose name you couple with that of President Carranza as a co-author. Indeed, about one-third of this long and revolutionary article of regulations governing natural resources can be traced directly to my book 'Latifundismo Mexicano; su Orígen y su Remedio,' which was published by the Federal Department of Fomento in 1916.

Let us now return to our muttons, or rather, Komspelter, and apply the property ideas of the Napoleonic code, founded on the investigations made by the democratic scientists of the French revolution and now restored in their fullness to the mineral code of Mexico. The prevailing Komspelter system is practically the old Roman allodial tenure which considered god-made natural resources as absolutely private property as man-made clothes or buildings.

Supposing Oklahoma had had the Latin system and had reserved all minerals to the State. By an areal tax she could then prevent large speculative holdings at the very opening of a new zinc, oil, or coal district. Later, by taxing only the royalty-value of the mineral output, the State could set the operators free from annual fines for their capital expenditures and reduce the cost of living for laborers by the abolition of all kinds of taxation, increasing the price of commodities. If even 50% of the royalty-value of minerals were taken by taxation, it would still leave 50% as a premium to operators to cover their risk. However, the forestallers and the land-gamblers would find no more easy pickings under such a system, and as these gentry are cunning enough largely to control the press, the lawyers, and the politicians, we are not likely soon to see them working for a living. Some day the real producers, both operators and laborers, will cease chasing the rainbow of sudden riches through unearned increments and unite to introduce a mineral-land system that will ensure a square deal.

Ixmiquilpan, Mexico, April 25. R. B. BRINSMADE.

Molecular Forces and Flotation

By WILL H. COGHILL

*Some of us are making an effort to ascertain the laws of nature and apply them to the flotation process, so that, some day, we may have not only an art of flotation, but also a science. Success will be achieved only through the co-operation of many builders, and it is the desire to aid in laying this foundation that prompts the publication of these notes.

The Principles of the Drop-Weight Method for Surface-Tension

Ferguson[1] states that 20 methods have been developed for the determination of surface-tension. The best known among these are the capillary rise and the drop-weight (weight of a falling drop) methods.

The numerical values obtained in surface-tension tests made by means of the capillary tube have always been accompanied by a shadow of doubt because of insufficient data on the contact-angle. Some investigators have boldly assigned a value to the angle at which the liquid meets the solid, and thus derived surface-tension from capillary rise. But Bigelow and Hunter[2] did not care to hazard so much. They expressed themselves as follows: "A liquid rises and is held at a definite height in a capillary tube through the action of two forces, first, the cohesion between the like particles of the liquid which, in the surface layer is denoted by the phrase 'surface-tension' and second, the adhesion between the liquid and the walls. The arrangement may be likened to a chain with two links, and when such a chain is strained to the breaking point it is the weaker link which gives away. So here, whichever is the weaker, adhesion or cohesion, must break first. The cohesion of a given liquid at one temperature must be considered as constant, not varying. We find the phenomenon of 'breaking' at different strains, therefore we must be measuring the force of adhesion. The force of cohesion must be greater in all our experiments, except those giving the highest results, and in those cases we have no sure means of knowing which of the two forces it is that gives way. Because of these considerations, we have intentionally avoided the use of the conventional values for surface-tension and have expressed our results in terms of the product of the radius into the height into the specific gravity, which is a measure of the weight held up, and leaves open the question as to what relation these values bear to surface-tension."

The drop-weight method for surface-tension determinations is probably the most reliable and destined to become the best known. It is based on what is known as the law of Tate. Anyone who has standardized the tip of a burette by counting the falling drops to find how many are required for a given volume will grasp the significance of Tate's law, which is,

$$\frac{\text{Drop weight}}{\text{Tip diameter}} = \text{a constant.}$$

This formula has been brought out recently in a modified and workable form by Harkins and Humphrey[3], to whom we are greatly indebted. In what follows I quote them freely.

Of these two methods (capillary rise and drop-weight) the first is much more sensitive to the action of impurities because the surface of the liquid involved in the measurement is made very small, whereas in the drop-weight method the surface is not only made relatively large but it is also renewed much more easily. It is not surprising therefore that the most concordant results on the surface-tension of a single liquid are obtained by the drop-weight method, and that duplicates run by this method, when it is properly applied, show a most remarkable agreement. However, when the results obtained by different workers on different liquids by this method are compared with determinations made by other methods, it is found that they show just as remarkable a disagreement, the deviation in some cases rising to 20% or even 40%. These bad results are due, however, not to any inherent fault in the method, but to the application of a faulty theory. Thus many workers have used the equation $W = 2\pi rT$ where W is the weight of the drop in grammes, and r the radius of the tip of the dropping-tube. This equation would be true only when the pendent drop is supported entirely by the surface-tension of the surficial film at the edge of the tip, and when all of the pendent drop falls, but this is far from the truth, for the drop that falls is not nearly all of the pendent drop.

The most complete treatment of the mathematical theory of the relation between the forms of drops and surface-tension is given in a book published in 1883 by Bashforth and Adams. Much later than this, in 1906, Lohnstein applied the general theory to the special case of the hanging drop just before its fall, and the residue left after the fall, and from the difference he obtained the magnitude of the falling drop itself. He arrived at the following expression:

$$W = 2\pi rTf\left(\sqrt{\frac{r'}{\frac{2T'}{d}}}\right)$$

in which $f\left(\sqrt{\frac{r'}{\frac{2T'}{d}}}\right)$ is a function of $\sqrt{\frac{r'}{\frac{2T'}{d}}}$; d is the ef-

*By permission of the Director of the U. S. Bureau of Mines.

[1]Ferguson, A., 'Science Progress', Jan. 1915, p. 428.

[2]Bigelow, S. L., Hunter, F. W., 'The function of the walls in capillary phenomena', Jour. Phys. Chem., Vol. 15, p. 377.

[3]Harkins, W. D., Humphrey, E. C., 'The drop weight method for the determination of surface-tension', Jour. Am. Chem. Soc., Vol. 38, Feb. 1916, p. 228.

fective density of the liquid, T' is the surface-tension in dynes per millimetre of length, and r' is the radius of dropping-tip in millimetres. The portion $\sqrt{\frac{2T'}{d}}$ is often expressed by a, the square of which is called the 'capillary constant'. The equation for the weight of a falling drop may then be written

$$W = 2\pi r T f(\tfrac{r'}{a}),$$

or, for surface-tension,

$$T = \frac{W}{2\pi r f(\frac{r'}{a})}.$$

Since $f(r'/a)$ varies from 1.0 to 0.6, it is evident that results obtained by the older equation may be increased by as much as 65% by the application of this correction. Lohnstein determined the values of the function of r'/a for different values of r'/a, and his calculation of these corrections from a theoretical standpoint makes it possible to use the drop-weight method for the determination of surface-tension, and, since, as has been stated, this is the most exact from an experimental standpoint of the

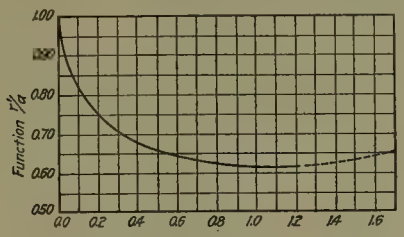


FIG. 1

methods used in work on capillarity, Lohnstein's work represents a great advance in our knowledge of this fundamental subject.

Unfortunately, however, when it becomes desirable to determine the surface-tension by this method, it is found that Lohnstein did not carry his calculation of these corrections to a sufficient degree of accuracy to make this method available for determinations where an accuracy greater than 4% is desired. It is important therefore that this correction, which is fundamental in work on capillarity, should be determined with a greater degree of accuracy. The corrections determined by Harkins and Humphrey are shown in the form of a curve in Fig. 1. In the figure the ordinates represent the values of the function of r'/a, and the abscissae, the values of r'/a.

The drop-weight method is well adapted to both the determination of the surface-tension of liquids at the free surface and the interfacial tension at a liquid-liquid interface. The most essential features of the drop-weight apparatus are that the tip shall be ground perfectly round, with sharp edges, and the diameter of the tip shall be of the proper magnitude to give a ratio between the radius of the tip (r') and (a) the square root of the capillary constant, such that Lohnstein's correction for the particular value of r'/a may be one that has been accurately determined, and also such that this correction shall not vary rapidly with the radius.

One should constantly study the shape of the drop as it develops on the dropping-tip. The liquid should spread over the end of the tip and leave a nucleus when the drop falls. To grind the tip to a thin shell, and to drop from the orifice is not good practice; only when the liquid spreads over the end of the tip and leaves a nucleus after the formation of each drop, can one be sure of the results. The proper manipulation and operation of drop-weight apparatus is an art unattainable by those whose ideas of accuracy and cleanliness are typified by the sloppy methods of titrating for cyanide and lime as practised in mills.

If the diameter of the dropping-tip is within a certain range, it may be standardized by a liquid of known tension and the factor thus obtained, applied in subsequent tests (the law of Tate); but since this 'certain range' can be determined only by reference to Lohnstein's work, it is well to follow him entirely.

The 'Journal of the American Chemical Society', Vol.

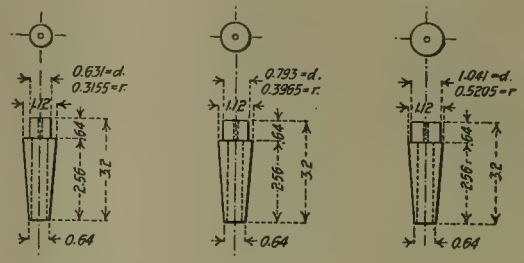


FIG. 2

39, April 1917, page 556, gives the surface-tension of 336 pure liquids. For this we are indebted to Messrs. Harkins, Davies, and Clark.

THE ART OF THE DROP-WEIGHT METHOD FOR SURFACE-TENSION

The drop-weight apparatus in use at the Pacific North-West station of the Bureau of Mines is shown in Plate I, A, B, and C. In A and B it consists of an ordinary burette with a dropping-tip slipped over the lower end and a rubber tube at the upper end for vacuum-control. The set-up in A is for surface-tension of a liquid against air, and in B, for interfacial tension of two liquids of which the heavier is dropped from the tip that is submerged in the lighter.

In C the apparatus consists of a burette to which a goose-neck has been sealed and ground to hold the dropping-tip. The upper end is provided with a vacuum-control to regulate the rate of dropping.

Three brass tips are shown in Fig. 2. The radii of the dropping-ends, 0.3155, 0.3965, and 0.5205 centimetres, were chosen so that some one of them would give for any particular liquid a value of $\frac{r'}{a}$ between 0.3 and 0.7, or close to this range, which is considered desirable.

The tips are readily turned out on a lathe. The over-

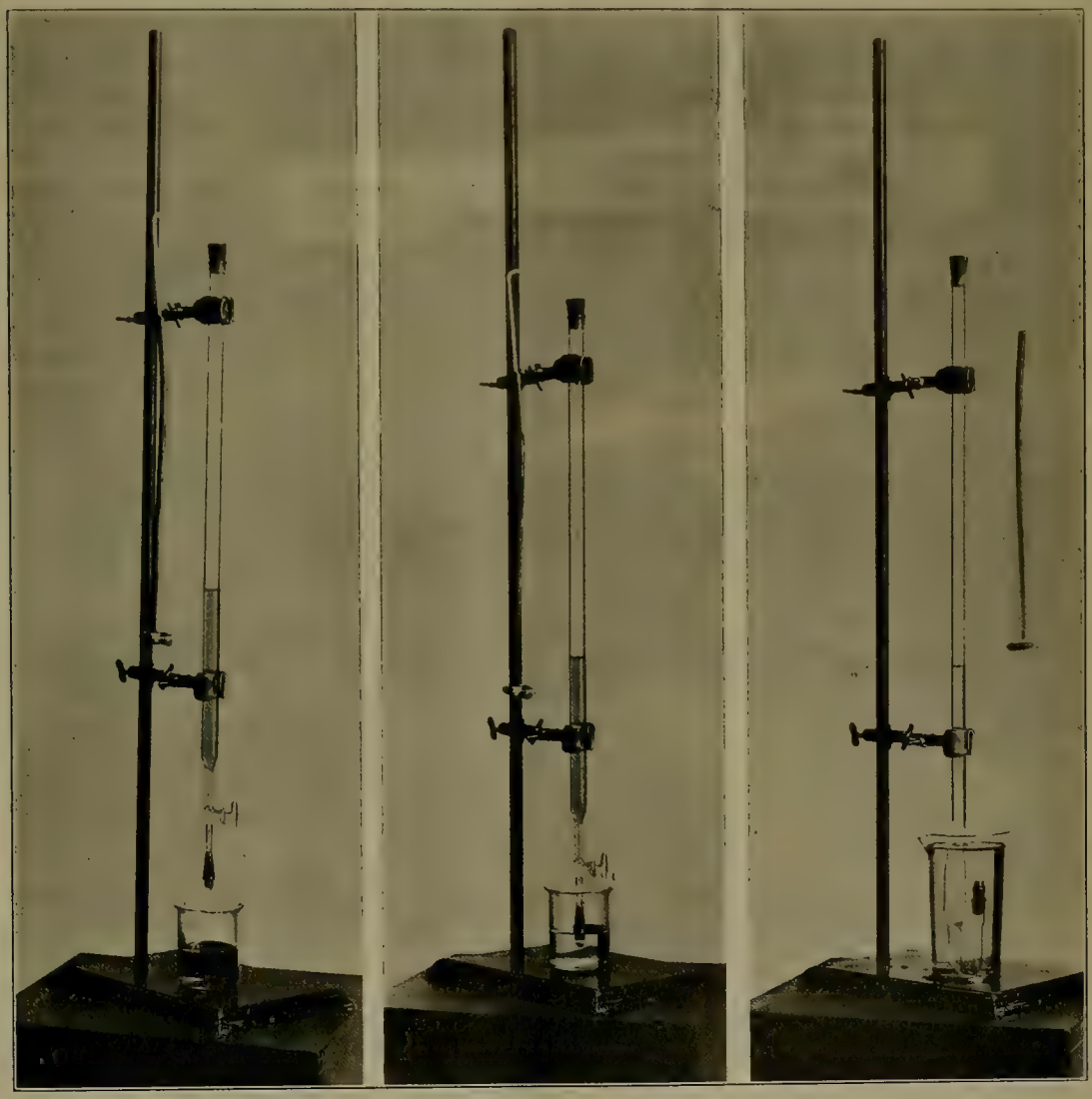
all dimension of 3.2 cm. has been found to give a convenient size. The tapering portion of the tip is a hollow shell, thin at the apexing end and increasing in thickness toward the shoulder. The inner conical opening is such that the tip will slip over the glass tip of the burette and fit tightly.

The cylindrical portion, at the end of which is the dropping-end, is ground perfectly true, both along the length and the end, giving a sharp edge. A small opening runs the length of the cylindrical portion to allow the liquid to flow with ease from the burette to the dropping-end.

The outer cone of the tip is made to fit the flared end of the goose-neck by means of a ground joint. In order to get a tight fit, the brass tip after being rolled lightly in fine wet emery dust is inserted into the flared end of the goose-neck and rolled in one direction to make a snug joint. All three tips are used in grinding the joint so that any one of them will fit.

Clean the burette thoroughly. A sodium dichromate-sulphuric acid mixture or ordinary washing-powder may be used. Rinse with distilled water and finally with alcohol, and let dry, keeping in mind all the time that a small amount of some contaminants produces a great effect on surface-tension.

At the beginning of a test, the dropping-end should be polished lightly on fine emery-cloth, which is laid on a plane surface so that the edge of the tip will not be blunted. If the liquid to be investigated does not then spread readily over the dropping-end, it is essential that it be made to do so, which can be done by dipping in turpentine and re-polishing.



A *B* *C*

DROP-WEIGHT APPARATUS FOR:
A, Surface Tension. *B*, Interfacial Tension, dropping downward. *C*, Interfacial Tension, dropping upward.

Before making a determination, two things should be ascertained:

(1) The value of a should be calculated from $\sqrt{\frac{2T}{d}}$, then the value of $\frac{r'}{a}$. Of course the value of T' has to be determined by gradual approximations. Note that d is the effective density, that T' is expressed in dynes per millimetre, and r' in $\frac{r'}{a}$ is also in millimetres. The choice of tip depends upon this calculation.

(2) In interfacial tension tests, ascertain which liquid spreads more easily on the tip, because this determines which liquid is to be dropped in the other.

Generally a dropping rate of six drops per minute will give results that are sufficiently accurate, although Lohnstein's theory is based upon the assumption that the pendent drop is forming at an infinitesimal rate at the moment it breaks away.

The following is a numerical example:

Use the equation

$$T = \frac{W}{2\pi r f\left(\sqrt{\frac{r'}{\frac{2T}{d}}}\right)} \text{ where}$$

W = weight of one drop.
r = radius of the dropping-end in centimetres.
T = surface-tension per centimetre in dynes, or grammes, depending on whether W is taken in dynes or grammes, respectively.
r' = radius in millimetres.
T' = tension in dynes per millimetre.
d = effective density, which in this example is unity.
W = 0.0915 gm. (using the smallest tip).
r = 0.3155 cm.
r' = 3.155 mm.

Determine the value of

$$\sqrt{\frac{r'}{\frac{2T'}{d}}} \text{ or } \frac{r'}{a}$$

by setting $2T' = 14.4$,

$$\sqrt{\frac{r'}{\frac{2T'}{d}}} = \frac{3.155}{\sqrt{\frac{14.4}{1}}} = 0.80 = \frac{r'}{a}$$

Now refer to the curve in Fig. 1 and find the value of $f(\frac{r'}{a})$ which corresponds to $\frac{r'}{a} = 0.80$.

It shows that $f(\frac{r'}{a}) = 0.618$.

The remaining part of the operation requires only a simple substitution to get the value of T, which is 0.0747 gm. (pure water). The assumed value of T' is so nearly correct that there is no need to repeat the calculation.

Some Surface-Tension Measurements

A. W. Fahrenwald[4] says: "While the film of oil on water may be only one molecule thick, or one twenty-five millionth of an inch, it will suffice to reduce the effective pull of the water from 73 to 43; this latter figure represents the effective surface-tension of water modified by oil as used in flotation."

It would be interesting if Mr. Fahrenwald would cite the research justifying the above numerical values. Though such figures have been used as a basis for a theoretical consideration, it is unlikely that they should be carried further.

It is thought that the following compilation of absolute values may be of interest since so much has been said about adsorption and its effect upon surface-tension. We have positive and negative adsorption, with a corresponding depression or elevation of surface-tension, depending upon whether the solute is concentrated in the surface or bulk, respectively.

In Fig. 3 are shown the surface-tension concentration curves for some of the liquids[5] which are mutually soluble in water in all proportions. They give emphasis to Gibbs' law that a small amount of dissolved substance may reduce surface-tension greatly but will not increase it much, for, upon reading from left to right, and regarding alcohol or acid as the solute, we see that a small amount produces a marked change, and, reading from right to left and regarding water as the solute, it takes a large quantity of it to produce an appreciable effect.

Since the effect of sulphuric acid upon the surface-tension of water has elicited some comment in the literature on flotation, and, lest it be inferred that all surface-tension curves are as regular as those in Fig. 3, the tension-concentration curve for sulphuric acid[6] in water is appended as Fig. 4.

Again there is a group of substances soluble in water in a limited degree whose effects have been determined by chemists. The effects of some of these substances—soap,[7] phenol[8] (carbolic acid), amyl alcohol,[9] nonylic (pelargonic) acid, and saponin,[10] are shown in Fig. 5.

The surface-tension concentration curves of all of these, except sulphuric acid, is convex on the side toward the axes.

Another generalization is that of Valson, namely, that equivalent salt solutions exhibit identical values of the surface-tension, even for varied concentrations. This is brought out by a comparison of Fig. 6 and 7. There would be indeed an approach toward coincidence of the

[4]Fahrenwald, A. W., 'Testing for the Flotation Process', p. 25, 1917.

[5]Morgan, J. L. R., Neidle, M., 'The weight of a falling drop and the laws of Tate', Jour. Am. Chem. Soc., Vol. 35, Dec. 1913, p. 1860.

[6]Morgan, J. L. R., Davis, C. E., 'The properties of mixed liquids. Sulphuric acid-water mixtures', Jour. Am. Chem. Soc., Vol. 38, March 1916, p. 563.

[7]Harkins, W. D., Davies, E. C. H., and Clark, G. L., 'The orientation of molecules in the surface of liquids', Jour. Am. Chem. Soc., Vol. 39, April 1917, p. 586.

[8]Morgan, J. L. R., Egloff, G., 'The properties of mixed liquids', Jour. Am. Chem. Soc., Vol. 38, April 1916, p. 851.

[9]Morgan, J. L. R., Neidle, M., 'The weight of a falling drop and the laws of Tate', Jour. Am. Chem. Soc., Vol. 35, Dec. 1913, p. 1860.

[10]Donnan, F. G., Barker, J. T., 'An experimental investigation of Gibbs' thermo-dynamical theory of interfacial concentration in the case of air-water interfaces', Proc. Royal Soc., London, Series A, Vol. 85, 1911, p. 557.

curves in Fig. 7, where concentration is expressed in relative number of molecules, if the temperature of the thiosulphate and nitrate solutions were reduced to that of the chloride and chromate. If these coincided after this temperature correction, it would mean that at the same number of mols, or equivalents of any one of the four salts for the same number of mols of water, the surface-tension would be the same. Ionization, and possibly other factors, must be considered before this generalization becomes rigid and gives coincident curves.[11]

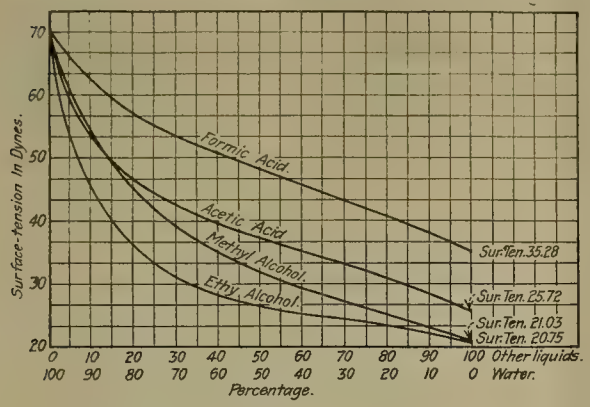


FIG. 3

Inorganic salts have been used in flotation, and sundry surface-tension effects have been ascribed to them by metallurgists. This is the chief reason for appending the above curves for inorganic substances. Note that the water, not the inorganic salt, is concentrated at the liquid-air surface, that is, the salt is negatively adsorbed.

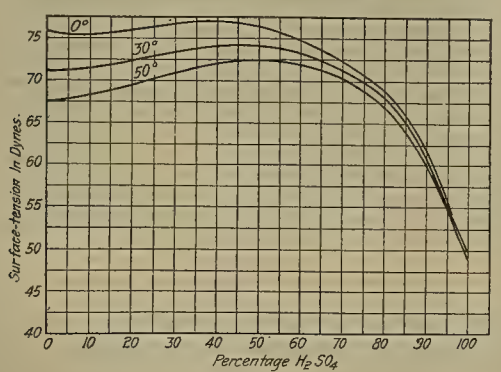


FIG. 4

There is yet another group of substances whose surface-tension effect upon water should be considered, namely, the 'flotation-oils'. This effect has been overrated by Fahrenwald, and technical literature is replete with statements like the following by Megraw.[12] He explains that: "The primary function, which has been clear since the inception of the flotation process, is that the oil serves to reduce surface-tension of water and thus provide for bubbles and froth of more lasting character than could be formed without its use." Continuing, he says: "It seems evident, therefore, that in addition to the function of reducing surface-tension, which the oil undoubtedly does accomplish, there must be further work that it performs." I believe that the science of flotation is more likely to place the emphasis upon "further work" than upon a marked reduction of surface-tension of mill-solutions.

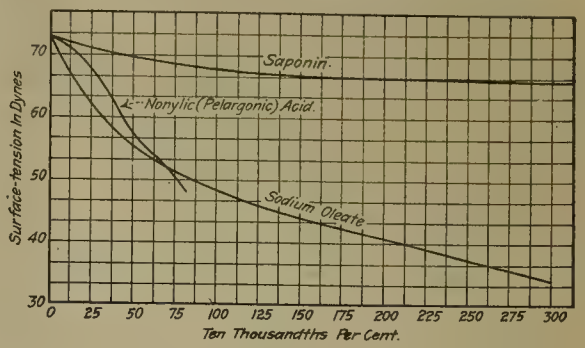


FIG. 5

It seems strange, in view of all that has been written about surface-tension, that there are no published data on the absolute values of the surface-tension of mill-solutions. E. H. Miller, of the U. S. Bureau of Mines, has recently made a series of such tests with the Minerals Separation laboratory type of machine. The results place the oils in two groups with an arbitrary dividing line of 65 dynes, and 0.1% oil. The effects of those oils of the first group, namely, those that give a surface-tension below 65 when present in the ratio of 1 to 1000 parts of water, are shown by curves in Fig. 8. In each test, water, to which a known amount of oil was added, was agitated for 10 minutes and filtered, after which the surface-tension was determined by the drop-weight method. The maximum effect as indicated on the drawing gives the tension of the water when contaminated under an arbitrary condition, to wit, where the oil and

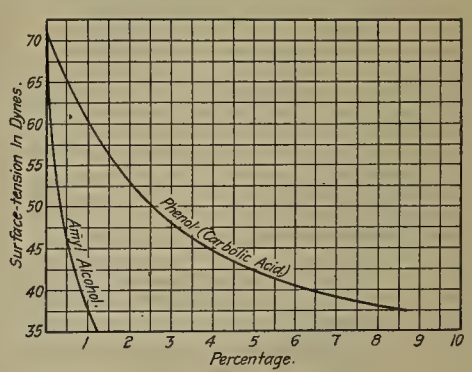


FIG. 6

[11]Morgan, J. L. R., Schramm, E., 'The drop-weight and surface-tension of molten hydrated salts, and their solutions', Jour. Am. Chem. Soc., Vol. 35, Dec. 1913, p. 1845.

[12]Megraw, H. A., 'The Flotation Process', p. 39, 1916.

water, in a ratio of 1:1, stood in contact for one hour. This "maximum effect" is an interesting property of many oils that, though they do not affect the tension when used in commercial quantities, have a small percentage of constituent soluble in water, where it is positively adsorbed. Several tests were made in the presence

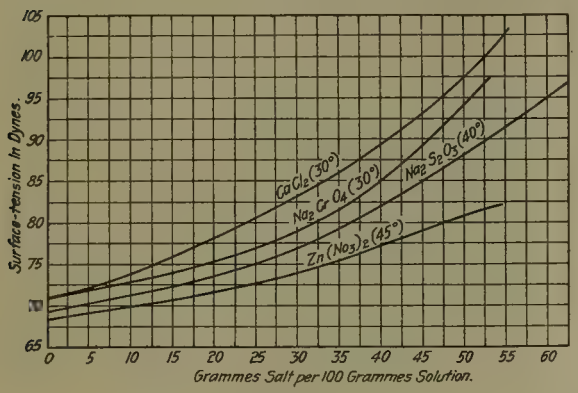


FIG. 7

of ore, and since the ore seemed to have no effect upon tension it was subsequently omitted.

The second group is shown in the accompanying table. The maximum effect only is noted because the surface-tension effect when used in working quantities was so small that it could not be satisfactorily determined with the available apparatus.

Note that 75% of the flotation-oils investigated fall in the second group.

The maximum surface-tension effect of a series of 'oils'

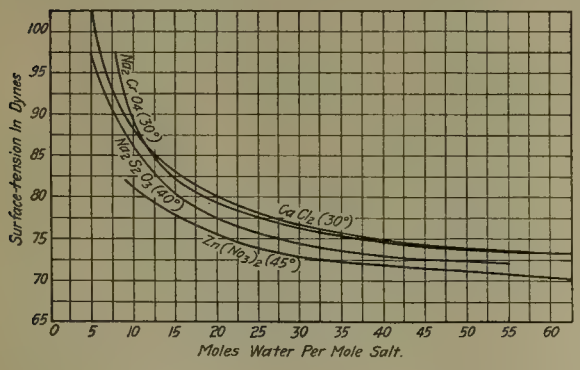


FIG. 8

when allowed to contaminate water by standing in contact with it for one hour. Ratio, 1:1.

Name of contaminant	Maximum effect (surface-tension)
Flotco, No. 11, Crude turpentine	59.3
" No. 14, Pine-tar oil	52.9
" No. 25, Carbolic creosote	53.0
" No. 28, Refined liquid coal-tar	72.0
P. T. & T. Co. No. 80, Crude pine-oil	51.2
" No. 90, Re-distilled tar-oil	58.3
" No. 1580, Special pine-oil	60.0
Hunter-Johnson Co. No. X	62.2
" No. XX	67.2
" No. XXX	66.0
" No. 250, Pine-tar oil	52.8
" No. EEE, Creosote-oil	71.5
Bureau Mines, Salt Lake, No. 141, Tar	46.4
Cresylic acid, (dark, 95%)	40.0
Oleic acid and water-glass	No effect

The determinations are the result of rapid work with crude drop-weight apparatus. They should be regarded therefore as a preliminary survey of the physical properties of flotation-oils.

An attorney once discoursed at great length upon

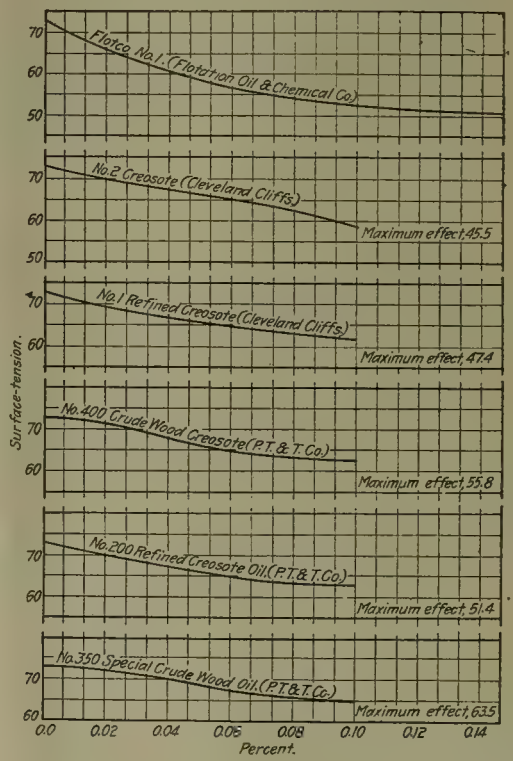


FIG. 9

surface-tension and said that the longevity of a bubble was increased by decreasing the contractible drawing force of surface-tension. It is hoped that metallurgists will never again allow such fallacies to be flaunted in their way by the legal fraternity without offering due challenge.

PROOF OF SURFICIAL CONCENTRATION OF A DISSOLVED SUBSTANCE

It was stated above that the difference in concentration between the surficial layer and the bulk of the solution is amenable to demonstration. Three of the best known proofs are the color test, chemical analysis, and drop-weight analysis.

A demonstration of the color test can be made in a few

minutes by shaking a dilute water solution of methyl violet in an elutriating flask and drawing off the bulk of the liquid through the stopper while the froth remains in the flask. After a few repetitions the difference in concentration is apparent by the color.[13]

The proof of adsorption by means of chemical analysis was probably the first one applied. The method is outlined in the following by Taylor.[14] He says: "The experimental demonstration of the equation, which was first derived by W. Gibbs in 1876-78, was long in being realized. In 1896 the author, working in Ostwald's laboratory, observed that the electric conductivity of a dilute aqueous solution of sodium oleate changed when the solution was stirred up with the electrodes, so as to produce foam on the surface, and gradually returned to its initial value as the bubbles slowly collapsed. This could be repeated as often as desired. Attempts to separate the foam on a large scale, in order to prove the difference by analytical methods, were unsuccessful. Zawidski (1900) effected the analytical proof in the case of salts and acetic acid by the simple expedient of adding saponin, and analyzing the foam carried over by bubbles of air. The differences in concentration were considerable. Miss Benson (1903), working with aqueous amyl alcohol, which, like soap solutions, does not require extraneous substances to produce foam, found the surface concentration to be 0.0394 n., the original concentration being 0.0375 n."

Drop-weight analysis is beautifully adapted to prove adsorption when the solute has a marked effect in reducing surface-tension. In a certain test where 500 gm. of ore was treated in the mechanical agitation type of machine with 4500 gm. of water and 0.12 gm. (0.003%) of Flotco No. 1, to float chalcopyrite, the tension of the overflow liquid (175 gm.), which was collected in the form of a froth and had therefore an enormous surface, was 69.3 while the tension of the underflow (4325 gm.) was 71.8. In another test where the solution samples were taken near the end of the run, and extra oil had been added to substitute for the solids that stabilized the froth during the first part of the run, the tensions of the overflow and underflow were 65.9 and 69.8, respectively.

This soluble oil was therefore concentrated in the overflow in accord with tests made to prove adsorption, as given in textbooks on colloid chemistry. Further, the percentage of oil in each product may be read off from a predetermined surface-tension concentration curve; this is drop-weight analysis, and it has not received sufficient attention in our laboratories.

NICKEL prices have been agreed upon between the International Nickel Co. and Bernard M. Baruch of the War Industries Board, the prices being 40c. per pound for the highest grade and 38c. for the lower grade.

[13]A pure methyl violet froth lacks the stability necessary for this separation, but this defect may be remedied by a trace of saponin.

[14]Taylor, W. W., 'The Chemistry of Colloids', p. 235, 1915.

Minerals Separation v. Butte & Superior

Following the opinion handed down by the U. S. Circuit Court of Appeals, which was published in the MINING AND SCIENTIFIC PRESS on May 25, an amendment to the decision has been made in view of the fact that the Butte & Superior company, by its own admission, had used 0.5% or less of oil per ton prior to January 7, 1917. The supplementary order modifying the decree is given below:

"Ross, Circuit Judge, Hunt, Circuit Judge, concurring, Morrow, Circuit Judge, concurring in the reversal but dissenting from the modification of the decree herein directed and as to costs:

Understanding from the presentation of this case that the real and pivotal question for the decision of this Court was whether or not under the decision of the Supreme Court in the case of Minerals Separation, Ltd. v. Hyde, 242 U. S. 261, the use of any oil by the appellant in quantity of one per cent, or less on the ore, constituted an infringement of the appellees' patent, and that the fact was undisputed that the appellant had not used as little as one-half of one per cent of oil in its process, in reversing the judgment of the court below we directed that court to dismiss the bill at the complainant's cost. Inasmuch, however, as it appears and is admitted that prior to and including January 7, 1917, the appellant did use in its process oil in quantities of one-half of one per cent and less, thereby in those instances infringing the patent of the appellees,

It is hereby ordered that the judgment of this Court herein rendered and entered May 13, 1918, be and hereby is corrected so as to read as follows:

The decree appealed from must be and is reversed and the case remanded with directions to the court below to so modify its decree as to accord with the opinions of the majority of this Court—the appellant to recover its costs on this appeal."

THE BRITISH GOVERNMENT is taking steps to exploit the deposits of monazite sand recently discovered by the Imperial Institute mineral survey, and the necessary plant is being shipped. Thoria, produced from this mineral, is extensively used in the manufacture of incandescent-gas mantles. Previous to the War the only deposits of importance were found in Brazil and India, both sources being in the hands of Germans, the monopoly being used to further the sale of Welsbach and other German mantles. The Indian mineral contains a higher proportion of thoria than the Brazilian monazite. The Ceylon survey has also shown that the island contains deposits of thorianite, the most valuable mineral of this class. The available amount is limited but the product has been marketed in London at over $8000 per ton.

PYRITE importations will be cut down gradually, under orders from the War Trade Board, until the minimum of 10,000 tons per month is reached in September. During 1917 this country imported from Spain 747,830 tons of pyrite, and from Canada 210,615 tons.

Concentration by Dense Solutions

By THOMAS M. CHANCE

*All gravity methods for the separation of ore from gangue, or of slate and other refuse from coal, are based upon differences in the falling velocities, in some fluid medium such as air or water, of the materials to be separated. As all materials falling in a vacuum have the same velocity, independent of the size, shape, weight, or specific gravity of their individual particles, it would be more accurate to describe the operation of these methods as depending upon the retardation of falling velocities effected by the resistance of a fluid medium, this retardation being greater for small or light particles than for large or heavy particles.

The separation of materials of different specific gravities by means of a fluid having a specific gravity greater than that of the lighter particles and less than that of the heavier particles has not been applied commercially, or on a large scale, to the separation of ores or to the washing of coal. The method has been limited to laboratory experimental work or to laboratory determinations for the purpose of checking up the work of jigs, classifiers, and other types of concentrating appliances. A solution of zinc chloride has thus come into general use in the laboratory to separate coal, bony coal, and slate, both to check up the work of coal-washing plants and for the purpose of making tests preliminary to the designing of coal-washing plants. The use of a heavy solution of some chemical in water has often been proposed for making such separations, especially in connection with the washing or preparation of coal. Practically insuperable difficulties, however, have prevented the commercial development of any such process, the difficulties being both physical and financial. The cost of the chemical used to make high-gravity solutions is usually prohibitive, and the freeing of the coal from all traces of the chemical is found to be practically impossible.

The method which it is the object of this paper to describe is based upon the facts that any relatively finely comminuted insoluble solid matter, such as sand, if mixed with a certain quantity of liquid, such as water, can be maintained suspended in the liquid by continuous agitation, and that the mixture, so long as agitation is maintained, will form a mass exhibiting physical properties similar to those of a fluid of relatively high specific gravity, including its ability to float solid bodies having less specific gravity, while permitting solid bodies of greater specific gravity to sink. The agitation of such a fluid mass may be effected and maintained by any suitable mechanical appliance, or by introducing liquid under pressure as jets or as a slowly rising current. When a fluid mass of a certain predetermined specific gravity has been produced in this manner, its specific gravity will remain constant so long as the agitation applied to it is not varied. The specific gravity of the fluid mass will be diminished by increasing the agitation, provided the necessary additional liquid is supplied for dilution of the fluid mass; while its specific gravity will be increased if the agitation be diminished. I have found that a mixture of sand and water can be used to produce a fluid mass having a specific gravity suitable for the separation of coal from bony coal, slate, fireclay, pyrite, and other impurities, and have used sand ranging from 20 or 30 mesh down to 100 or 200 mesh, or finer, and find that fluid masses with specific gravities ranging from 1.20 to 1.75 are easily produced and can be maintained constant for an indefinite period at any desired gravity within these limits.

I have found also that fluid masses having a specific gravity high enough to float quartz, feldspar, limestone, and other rocks, can readily be produced by using magnetic iron-ore sand and water instead of quartz sand and water. Other heavy materials can be used, such as ore concentrates of galena, or metallic copper, for producing fluid masses having very high specific gravities.

For the practical separation of materials of different specific gravities by this method, the following observations are evident: (1) Every particle of material having a lower specific gravity than that of the fluid mass will float; that is, the separation will be independent of the size of the materials to be separated. If the fluid mass be contained in a receptacle large enough to permit the introduction of large lumps, it is possible to dump the ore or coal, as mined, without any preliminary sizing, whereupon, every particle of less specific gravity than the fluid mass will float, irrespective of its size or shape. (2) As every particle of material, irrespective of its size or shape, having greater specific gravity than the fluid mass will sink, no preliminary sizing is necessary to insure the sinking of all material having a higher specific gravity than that of the fluid mass. (3) The insoluble material, such as sand, used for producing the fluid mass, can be washed readily from the materials which have been so separated, and thus can be recovered and returned to the fluid mass for continuous use.

This method offers facilities for making differential separation of materials which may be of nearly the same specific gravity, because the fluid mass can be so adjusted as to float one material while permitting the other to sink, although the difference between their specific gravities may be slight. This characteristic can be applied to the separation even of low-ash from high-ash coal, of coal from bony coal, or of bony coal from slate; and with ores it may be utilized for separating waste rock from rock that contains sufficient ore to justify crushing and concentration, as well as for the separation of ore-bearing minerals of different specific gravities.

The development of this method has been so recent that it has not yet been introduced commercially, attention having been directed wholly to perfecting appliances suitable for its practical application.

*Abstract: A New Method of Separating Materials of Different Specific Gravities, February 1918 meeting, A. I. M. E.

The Calico District, California

By LEROY A. PALMER

INTRODUCTION. The Calico mountains are situated in the western part of the Mojave desert in San Bernardino county, California. They extend along the north side of the Mojave river from near Daggett, the junction of the Salt Lake and Santa Fe railroads, to a point opposite Barstow. The main portion of the range, which is the only part that contains mineral deposits of economic value, lies north of the old town of Daggett and of the newer town of Yermo, a division-point on the Salt Lake route four miles from Calico. This is one of the few silver-mining centres of California.

HISTORY. While the days of the greatest activity are not so remote but that undoubtedly there are men living who recall them, I did not find anyone who could speak authoritatively on the subject. There were two towns, Calico, the silver producer, which was by far the larger, and Borate, at the borax mines. There was also a small settlement, West Calico, in the vicinity of the Waterloo mine, about two miles south-west of Calico. The first discovery of silver ore was made at Calico about 1880. The town grew rapidly, several mines became productive, and the district attained great prosperity in the late 'eighties. The population grew from 1000 to 4000. It is probable that, in the time of greatest activity, there were about 700 miners engaged at this point. The district then was reached by two railroads from the Santa Fe line at Daggett; one forked near the foothills, branching to the Waterloo mine and to a point near the town; the other was built with three rails, for standard and narrow gauge, as far as the borax mill, and thence as a narrow gauge up Borate canyon to Borate. In 1885 application was made through the Superior Judge of San Bernardino county to the Government for a patent to the townsite of Calico. This could not be granted immediately as the site chosen had never been officially surveyed. The application was placed on file, and when the surveys were made some years later the site was tied in, platted on the official maps, and notice sent to the presiding superior judge that patent would issue as soon as certain minor requirements were fulfilled. To this notice the judge replied that there was no longer any necessity for a patent, as the town of Calico had ceased to exist, not a single resident remaining. During the late 'eighties about a dozen mines continued to produce, and at least half-a-dozen mills, some having as many as 60 stamps, were in operation. The ores contained chlorides and bromides of silver, which were treated by pan amalgamation. The bullion produced was exceptionally pure, 990 fine being common. The two larger companies became involved in a long and expensive litigation, and soon after came the 'silver panic' of 1893. The operators at Calico did their best to weather the storm, but the financial crisis brought ruin, and the mines were abandoned to lessees. Desultory production persisted until 1897. Since then the only sign of life has been an occasional chlorider hunting bunches of high-grade that might have been overlooked. At the time of my visit, in February 1918, there were five men at work.

GEOLOGY. The Calico range extends several miles along the north side of the Mojave river as a series of detached mountains of moderate height broken by intervening valleys and plateaus. The name 'Calico' was given because of the great variety of color from lava flows and sedimentary beds of distinctive hues, which, in the shifting rays of the sun, are multiplied and exaggerated. The portion of the range that is of economic interest extends due east and west about six miles, with a maximum



SOUTHERN CALIFORNIA. CALICO IS IN SAN BERNARDINO COUNTY

width of less than three miles. Of this area W. H. Storms[1] said: "The geology of the Calico mountains at first sight looks simple enough, but a more thorough investigation quickly convinced me that there were structural problems to be studied of more than passing importance." My own conclusions coincide with those of Storms, to which I may add that the region is to be recommended for ideal illustrations of the phenomena accompanying eruptive action.

ERUPTIVES. The principal rock in the vicinity of the town of Calico is rhyolite, appearing as a series of flows and effusions. Massive rhyolite exists in many forms and in a great variety of colors, the most prominent being a reddish purple; it is also found in sombre tints, from

[1]'Calico Mining District,' 11th Rep. of California State Mineralogist.

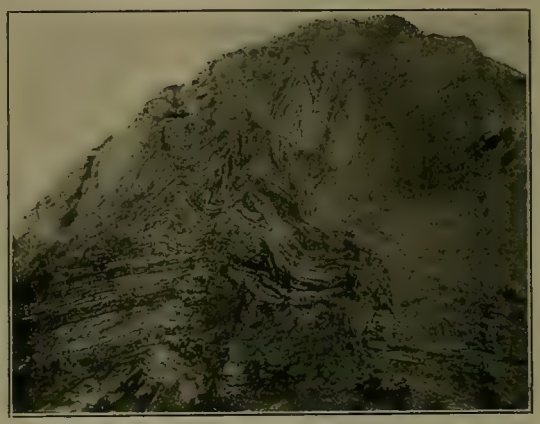
brown to black, and dark to brilliant green. The massive forms generally show quartz with the aid of a good lens. In the earlier flows the rock is massive, dense, and fine-grained. The later flows show breccias spotted with angular pebbles of the same composition as the groundmass, and among the highest flows are porphyries, with well formed and easily recognizable phenocrysts. True conglomerate was observed rarely, but there was one example of a good-sized chunk of granite embedded in the rhyolite.

Numerous craters of remarkably uniform shape were found. Flow-structure is prominently developed in the massive rhyolite. The flows dip in opposite directions—north and south—from the summit of the range. Regular jointing is seen, but columnar structure is wholly absent, as would be expected in a rock so acid. There are numerous features that tend to show that the mass was erupted in a highly fluid state. In one ravine, I found a low perpendicular face in which is a small cave, formed when the crust of the lava became chilled and stiff, while the warmer and more fluid portion beneath flowed onward and left an arching roof over a small room about three feet high. The lower portion of this roof had remained pasty, and molten lava dripped from it in spots, forming stalactites, from which lava dropped to the floor until, in some cases, the stalagmites met the stalactites and formed lava-columns.

The tuffs likewise are interesting. They are principally white and light-yellow to buff. Their most notable occurrence is along the summit of the range, where they are frequently found as breccias enclosing fragments of the massive rhyolite. Stratification is distinct in many localities and, unless the beds have been displaced, the dip is north or south, away from the crest.

The character of the rocks is markedly reflected in the topography. Save for a few scattered outliers the soft tuffs, which presumably covered the entire country at one time, have been eroded, except from the higher portions of the range. Removal of the tuffs exposed the massive rhyolite, which yielded to erosion much more slowly, and with comparative uniformity, except where a gulch or canyon marks the course of a stream. The tuffs, on the other hand, exhibit pronounced differential erosion, as a result of which they form sharp spires and castellated crags, intersected by precipitous canyons. Undoubtedly the eruptives are very young. Lindgren[2] says they are probably of early Pliocene age, but he does not state on what he bases this conclusion other than "the form of the mountains, the often occurring craters, and finally the great masses of tufas give evidence in favor of their comparatively recent origin." Storms[3] fixes the age of the Calico uplift as probably Oligocene. The eruptives are certainly Tertiary and probably belong to the later portion of that age.

SEDIMENTS. In the western part of the district the sediments form a belt surrounding the foothills. In the eastern part they extend much higher up the mountain-slope and are more widely distributed. Clays and sands predominate, but intercalated with them are strata of tuff, thin sheets of lava, principally the purple variety of rhyolite, occasional chert and jasper, small beds of conglomerate and breccia, and occasional limestone. Pack[4] described these beds in considerable detail, as he found them in the Barstow syncline some miles to the west. He classed them in three divisions, having a total thickness of at least 3000 ft. These divisions are reproduced at Calico, but I would not venture an opinion as to their thickness. The character of the beds has a marked influence on the topography. Going up Borate canyon from the valley there is first a region of moderate relief, consisting of shallow gullies and rounded hills. Farther



CONTORTED LAKE-BEDS

up are many steep-sided gulches of considerable depth, presenting a typical illustration of 'bad land' topography. The uppermost portion of the sediments presents again a region of moderate relief.

STRUCTURE. The locality has been described by Lindgren and Storms, but their conclusions are not entirely in accord. My own agree in part with each. Lindgren refers to the rhyolites and tuffs "together with the clay and sand strata derived from them." Storms says, "the lake sediments were from some other source than the Calicos, as they are found on the high ridges and peaks," and again he speaks of the "heavy accumulations of detritus in the shape of clays, sandstones, conglomerates, and breccias whose constituent parts were almost all derived from the disintegration of earlier volcanic eruptions." The statement that the sediments are found on the high ridges is true only of the region about Borate, where a fault, which shows plainly from the valley, and which strikes somewhat west of north, has an upthrow on the east so that the lake-beds on that side appear at a much greater elevation than on the west. I am of the opinion that the existing structure can be accounted for as follows: Deposition of the sediments was contemporaneous with the volcanic extrusions spread over the bot-

[2]'Silver Mines of Calico, California', by Waldemar Lindgren. Trans. A. I. M. E., Vol. 15.

[3]Loc. cit.

[4]'The Barstow-Kramer Region'. H. W. Pack, U. S. G. S. Bull. 541.

tom of an extensive lake. This is indicated by thin beds of rhyolite intercalated with the sediments, and perhaps by the intercalated tuffs, although the latter may have been eroded from some higher point. As volcanic activity increased the mountains of lava, breccia, and tuff were built up, and the sediments, derived in part, no doubt, from the erosion of this mountain mass, continued to deposit about it until the waters of the lake in which this



CALICO, CALIFORNIA

action was taking place had subsided. Finally adjustments of the surface took place, accompanied by faulting and folding, which brought the volcanics and the sediments into still more intimate relationship. The igneous rocks yielded by faulting and crushing, while the softer sediments gave way preferably by folding. The sediments consist of many thin beds. Although some of them, such as the lavas, cherts, and jaspers, and some of the sandstones, are hard and brittle, the individual strata are thin and are cushioned by the intercalated sands and clays, which are soft and plastic. This forms an ideal condition for deformation without fracturing. The sediments present some of the most highly distorted forms that I have ever seen. The trend of the folds is mainly along east-west axes, corresponding to the major fractures in the rhyolite, but there are many minor and complex folds, indicating that the pressure was applied from many directions.



BAD LANDS IN LAKE-BED FORMATION

ORE DEPOSITS. The ores of the district are of two kinds chiefly, chlorides and bromides of silver at Calico, and colemanite (borate of lime) at Borate. Recent exploration by lessees has shown the existence near West Calico of a vein in which the principal metal is gold. The silver ores were found in, or related to, the zones of structural weakness, and also as irregular pockety deposits. Whereas the trend of the fractures is mainly east and west, toward the western portion of the district they swing toward the north. Some of the veins were in fissures, with well-defined and clean-cut walls, in places with pronounced slickensiding, but it is probable that true fissure deposits were not as common as those formed in fracture-zones. These zones accompanied the faulting, consisting of series of parallel main fractures crossed irregularly by innumerable smaller ones. The channels thus formed were sealed by deposits from mineral-bearing solutions, which were undoubtedly ascending, and the result was a stockwork so intricate that it was necessary, in most cases, to mine and treat the entire mass to recover the valuable mineral. The gangue was principally quartz and barite, with subordinate amounts of iron and manganese oxides, and lead carbonate. Recent work by lessees shows an increase in the amount of lead carbonate in some of the veins. The veins vary in width from that of a knife-blade up to 10 ft. or more, averaging about three feet. The deposits along the fracture-zones were irregular; sometimes only a small pocket was found; again the orebody would yield a large stope. The pocket deposits were found in the tuff near the surface. None of these came directly under my observation. Lindgren describes them as containing the

same ores as the fissure (and fracture) deposits, not far distant from them, usually lower, and sometimes following the bedding-planes of the tuff; hence, he concludes, they are doubtless overflows from the fissures and fracture-zones.

Schrader* has stated that there are a number of mineralized districts of strikingly similar formation extending from Oatman, Arizona, to the longitude of Barstow, California, and he cites the Calico mountains as one of them. A comparison of the eruptive portion of the Calico with the Oatman district is interesting. The formation at Oatman is a pre-Cambrian complex followed by metamorphosed Paleozoic limestones and shales, and by flows and effusions of Tertiary andesite and Quaternary basalt. Considering these in reverse order at Calico, the basalt, which is wholly post-mineral, is lacking. In place of the andesites are rhyolite flows and tuffs. Here the similarity ends, but about ten miles farther north, in the Goldstone district, are limestones and shales, uncorrelated but unquestionably pre-Tertiary. Still farther north, above Goldstone, are granite mountains, but I cannot state their relations to the limestones and shales. It should be noted, however, that at least one occurrence of fragmentary granite was observed in the rhyolite at Calico. At Oatman there were at least two periods of parallel fracturing. The first opened fissures in the andesite, which were sealed by calcite veins. The second fractured the calcite veins, permitting the circulation of silicious solutions and the replacement of the calcite by quartz. At Calico there was undoubtedly more than one period of fracturing, as shown by the parallel breaks and by the numerous minor fractures associated with the mineral deposits, and this fracturing was prior to the ore deposition. These points tend to confirm Schrader's conclusions, and indicate an interesting similarity between the two districts.

Borax. The borax occurs as colemanite, $Ca_2B_6O_{11}\cdot 5H_2O$. Many thin seams of unworkable thickness of the 'cotton-ball', as the miners call it, are found throughout the sedimentary beds. The workable deposits near Borate present two exposures, which can be traced along the hillside for nearly two miles. Beyond this the quality is poor and the thickness diminishes. Campbell[5] found the thickness of the beds to range from 5 to 30 ft., and he stated that there was some doubt as to whether the two outcrops mark different beds or result from a sharp fold. The average thickness of the beds now being mined is approximately five feet. Development has not yet settled the question as to the identity of the beds. Storms gives it as his opinion that the colemanite was formed as a residual deposit from the evaporation of water containing calcium borate, the deposition taking place in a basin, which was cut off from a larger lake by the recession of the waters. This is the generally accepted theory as to the origin of saline and similar deposits, but Gale[6], in discussing the origin of a sedimentary deposit of magnesite in similar strata, and in the same topographic basin as the borax beds, having lime in the same series, advances the theory that the deposition may have been the result of reaction between magnesian and lime-bearing solutions, the one existent in the water of lakes and the other fed to it by springs. The colemanite is sorted, and with reasonable care a product containing more than 60% boric acid is obtained. Across the range from Borate in the valley is an extensive deposit of 'mud borax', that is, colemanite mixed with the sand and clay of the lake-beds so as to carry only about 15% boric acid. Several attempts have been made to work these deposits, but none has yet been successful. One company conducted operations on an extensive scale and expended a considerable sum of money unprofitably.

Economic Conditions. The future of the district is by no means certain. At most of the mines the high-grade ores were exhausted, but the ordinary 'chlorider' does not hurt himself by hard work and yet appears to make a living, so there may be deposits that will pay for small-scale leasing if carried on systematically. I received fairly credible reports that a large amount of ore containing five to six ounces of silver per ton still remains. If this be true there is a chance of renewed activity at the prevailing price of silver. The mines were worked apparently in an unsystematic manner, without thought of the future. Timbers were costly and were used sparingly, even in the larger stopes. The old dumps from the mills, aggregating many thousand tons, are worthy of consideration. Two years ago a cyanide plant was built to treat the tailing of the old Runover mill, but the attempt was not successful. This was considered to be due to the faulty character of the mill and its operation.

Calico is only four miles from Yermo, on the main line of the Salt Lake Route, and is connected with it by a good road. Motor-truck haulage should not be expensive. Water is to be had in the valley within 50 ft. of the surface, and was obtained from that source and pumped to tanks above the town when the district was active. Recent developments at Borate lead to the conclusion that these deposits are not as near exhaustion as they were once supposed to be. They are controlled by the Pacific Coast Borax Co., which holds patent to all the land on which known deposits of economic value exist.

Sulphuric acid is quoted by dealers at $60 per ton for the 66° B. grade, and 60° acid brings $55 per ton. Manufacturers are out of the market, and are not accepting new business except where orders are accompanied by a Government requisition.

Hydrochloric acid is showing greater activity, owing to an increased demand by the Government. The price for 18° acid in carboys is 2½c. per pound; for 20° acid 3c.; and for 22° acid 3½c. spot.

*Schrader, F. C., 'Geology and Ore Deposits of Mohave County, Arizona', Trans. A. I. M. E. Bull. 119, 1916, p. 1935.

[5]'Borax Deposits of Eastern California', by M. Campbell. U. S. G. S. Bull. 213.

[6]'Late Developments of Magnesite Deposits in California and Nevada', by H. S. Gale. U. S. G. S. Bull. 540.

Man-Power

By J. PARKE CHANNING

*We are accustomed to think that we are efficient in the United States, particularly with respect to such things as mining and manufacturing. The conduct of the War has demanded in England and in France a complete readjustment of manufacturing methods and plans, and today England is probably as efficient a country as there is in the world, not even excepting Germany. This is all the more remarkable because it has been notorious for years that England has been inefficient in her manufacturing and the country has been flooded with things 'made in Germany.' Today England is almost a socialistic community and the State is doing almost everything. England is now in such a position that practically everyone in the country is engaged in industry necessary for the conduct of the War, and this has been accomplished by increasing the efficiency both of her tools and of her man-power.

In the United States we certainly have been efficient so far as machines and perhaps so far as methods have been concerned, but we have not been efficient in the utilization of our man-power. Before the War, our labor was undoubtedly far more efficient than that of England, but it certainly was not so highly efficient as it should have been, and the problem that confronts us today, and will all the more confront us after the War, is to make our man-power efficient. England has had a taste of what you may call state-socialism, and her laboring men are not going to be content to return to the old order of things. There is one feature of the labor problem in England which has permitted her to reach this condition of state-socialism with comparative rapidity; this is that practically all of her laborers are English; she has little or no foreign population. While an Englishman may be a strong union-man and ready to fight his employer tooth and nail, at heart he is still a British subject, and when his country was in danger he rose to the occasion.

In the United States we have such an admixture of unassimilated foreigners that the problem is more difficult, and as yet we have not been brought to that point of stress which has arrived in England. But if we are to carry the War to a successful conclusion, and if we are to increase our efficiency after the War, we must introduce methods which will Americanize these foreigners and give them our own point of view. We have been called the 'melting-pot', but it is a question whether even our melting is efficient, and whether at the top of the crucible there does not accumulate too much dross and at the bottom not enough clear alloy.

I wonder if any large number in this country have read the so-called reconstruction program of the British labor party. It will, of course, be subject to a great many modifications before it is adopted by the party, and no doubt still further and greater modifications will be made before any or all of it is accomplished. It is largely socialistic and has for its basis four principles or pillars, as they choose to call them, of the house which they hope to erect. These four pillars are:

1. The universal enforcement of the national minimum.
2. The democratic control of industry.
3. The revolution in national finance.
4. Use of surplus wealth for the common good.

If these four demands are carried out, then surely England will be a socialistic State.

I am not prepared to say how much of this program can, or will, be carried out, but it shows the trend of thought of the laboring man in England. He has seen his wages increased so as to keep pace with the growing cost of living, he has seen the profiteer discouraged, and he is more than ever convinced that in the past he has not been getting his fair share of the product of his toil; and, I believe, at the same time he is realizing that undoubtedly in the past he has not done his proper share in increasing the wealth of the country. Nor can he be blamed for this, because, seeing large fortunes grow up before his eyes, while he gets but a small proportion of it, the incentive to increased efficiency has not been great. He realizes that when the War is over, unless the greatest care is used in the re-organization of the regular industries, there will be an immense amount of unemployment; that this, if unchecked or uncared for, will result in an over-supply of labor, and, if the old standard is maintained, a corresponding diminution in wages. This he feels should not be; hence his insistence of the first principle of a minimum wage. And the minimum wage that he asks for is certainly not a high one, being 30s. or, we will say, $7.50 per week.

In demanding democratic control of industry he has observed such good results attained in war work that he sees no reason why this control of industry should not be just as efficient under after-war conditions.

In the third pillar, the revolution in national finance, he demands that taxation shall be so adjusted that it will yield the necessary revenue to the Government without encroaching upon the prescribed national minimum standard of life of any family whatsoever; without hampering production or discouraging any useful personal effort, and with the nearest approximation to equality of sacrifice. Apparently he is not a protectionist and repudiates all proposals for a protective tariff; however, this may be disguised. In this point they agree with Courtenay De Kalb, a prominent mining engineer.

*Presented at a meeting of the Boston Section of the American Institute of Mining Engineers, March 15, 1918.

who, in the December 1917 number of the 'Atlantic Monthly', has a most excellent article on the 'Formula for Peace,' in which he states, that, if after the War we can have an industrial world in which there are no protective tariffs and no subsidies, in which every nation is engaged in producing those articles for which it is best adapted, that then there will be less incentive for war.

The fourth pillar of the English laborite is that the surplus wealth shall be used for the common good. They say that we have allowed the riches of our mines, the rental value of the land superior to the margin of cultivation, the extra profits of the fortunate capitalists, and even the material outcome of scientific discoveries, to be absorbed by individual profiteers, and he demands that in the future a large proportion of this surplus shall be applied to the common good.

You must realize that the English labor party is not like the Bolsheviki of Russia. It is not carried away with the beliefs of Lenine and Trotzky, that the proletariat are the men to manage the country. The English laborer frankly realizes the importance of brains and education, and admits that the highest success of the country cannot be obtained without the aid of those who plan, and manage, and invent, nor would he object to allowing these men to get their fair share of the profits. Evidently the class against which his program is aimed is comprised of those more or less sharp and shrewd men who, without anything more than commercial ability, of themselves reap the advantages of the brains and muscles of others.

It is not for me, nor am I a sufficient student of economics, to pass upon this program. It has certain merits, and I am calling it to your attention only that you may see that just this same thing is liable to come up in the United States. And the trouble will be that the pendulum will very likely swing too far if the employer class in the United States does not give more attention to the laborer and see that his condition is improved. You, as engineers, are in the position to act as the instruments for carrying out this necessary work. Whether it be in a mine or a manufacturing plant, I believe I can say that today a large proportion of the managers and executives are engineers, and the proportion is constantly increasing.

The question to be clearly faced is, are we properly trained to bring about this improvement in our social conditions, to improve the living conditions of our laborers and at the same time to improve their efficiency. I fear that a great many of us are not. We may be good technical men but we are not sociologists nor psychologists. We understand production of kilowatt-hours from coal or from water-power, we understand the machine by which it is utilized, but we do not understand the machine which produces our man-power.

I recently attended a conference at Columbia University, at which the question of giving the engineering students a course in human engineering was discussed, and I came away with the idea that the authorities were beginning to realize that this was of paramount importance and that this training must be given the engineering student before he can be turned out as a man capable of eventually holding a high executive position. Many of the students have the ambition to hold high positions, but at the same time, in the most naive manner, announce that they have no desire to have anything to do with the working-men themselves. In my opinion, there never was a time when it was so necessary to impress upon engineers and engineering students the importance of this human side of engineering.

I wonder how many of you can tell me what trade-unionism is—you who have had to deal with unions and have had strikes? The fact is that none of you can tell what trade-unionism is because trade-unionism is not an entity but a term of broad generalization covering a great many distinct aspects of the labor problem. Some of you who, perhaps, are railroad superintendents, whose knowledge of trade-unionism is based upon your contact with the Brotherhood of Locomotive Engineers, would give one definition; others, who have been managing a mine in the Rocky Mountains, whose contact has been with the Western Federation of Miners, would give another definition. Specifically each of you would be right from his own point of view, but neither of the definitions would cover trade-unionism as a whole. A few weeks ago I might have been rash enough to attempt a definition, but in the meantime I have read Professor Hoxie's work on 'Trade Unionism in the United States,' and my ideas on the subject have been much clarified. I would advise every one who has anything to do with trade-unionism to get this work and not merely read it but study it as you would study a book on electric motors to find the difference between an induction motor and a synchronous motor, between one that was simply wound and one that was compound wound.

You will find that trade-unionism can be classified under two broad general heads, one based on structural varieties, and one on functional varieties. As Professor Hoxie points out, there are four divisions under each head and any one of the structural varieties may function in any one of four different ways. You will learn that while, to you, decreased output on the part of the laborer seems inexcusable, yet, for him, it has an intense and immediate value. You will find the reason why he insists that the good and the poor workman shall each turn out the same amount every day, and you will find that he has most excellent reasons for this, reasons that probably never entered your head. You will learn why the locomotive engineers of the United States can have one strong central national union, and why this is impossible with the men who dig ditches. You will discover why the Knights of Labor movement failed and why the American Federation of Labor has succeeded. There is one basic and most important factor which you must realize, namely, that, talk as you may, the interest of the laborer and the interest of the employer are diametrically opposed, just as the interest of the buyer and the interest of the seller are opposed, that from the very nature of things they can never be identical, and that the best that can ever be reached is a compromise. And who is better qualified to bring about this compromise than the well

trained engineering manager who, with his broad knowledge and experience with both capitalist and laborer, is enabled to act as an arbiter or a judge and arrive at a decision at least fairly equitable.

It is the engineers of this country who are in a position to solve the labor problem, or at least to produce a solution as nearly ideal as possible. It is you who are to convince the employer that, in the long run, he is going to be better off by increasing the wages of his men, reducing their hours of work, and improving their living conditions. It is you who must convince the laborer that it is to his interest to work as efficiently as he can and to produce as large an output as is possible. You will have to do this by education. It is difficult to convince a laborer that by increasing his efficiency and his output he helps himself, because he only looks to immediate results. But do not be carried away with the idea that because the laboring man upholds an economic fallacy you cannot convince him of his error.

About ten years ago I started to develop a low-grade copper mine in Arizona. As mine superintendent I had N. Oliver Lawton, a member of this Institute, whose experience at Lake Superior has made him familiar with what is known as the one-man air-drill. This is a light machine weighing about 125 lb., which can be readily set up and operated by one man. We started to use these in Arizona where, before, nothing but the larger and heavier machine, requiring two men, was in use. There was an immediate opposition from the men and we were accused of trying to throw half the normal number of miners out of work. Whenever I went through the mine I took the opportunity to tell the men that this orebody, up to that time, had not been considered 'ore', that it was 'rock', and that nobody thought it was worth exploiting; that, far from throwing one man out of work, we were giving two men jobs, that if two men had to work on a drill the cost of mining would be so high that the material would not be ore, but that if we gave each man a drill and put him to work in a separate drift, then the rock would become ore, that these men would have employment and that a new industry would be started. About three months of this propaganda convinced the men of the truth of our claim, and in a short time it would have been impossible to get the men to go back to the old two-man drill because each man now felt that he stood on his own feet and got credit for the whole distance he drifted. This is only one example, but it indicates what can be done by education. The old-time manager or old-time superintendent would simply have said, take the job or leave it; but this is not the attitude for the modern engineer.

The assertion is made in Washington that it is difficult to get executives for war work, particularly executives who understand the handling of man-power. I am told that some of the new plants for war industries have been most carefully laid out, taking into consideration the routes by which material is to arrive at the plant, its progress through the works, and its method of removal, the supply of water, coal, and other material, but in a great many cases no thought has been given to the handling of the men, to their housing, or, if they are to be brought from an adjacent town, of the method of transporting them to and from the plant. These have been left to a hit or miss adjustment after the plant was up.

For several years the industrial department of the Y. M. C. A. has had a secretary who has devoted himself almost entirely to impressing upon the engineering schools the necessity for having a course in human engineering, and in 1916, under their auspices, the first convention to discuss the human side of engineering was held in Ohio. They lay great stress upon the advantages which would accrue to engineering students if they had an insight into the mental operations of the laboring-man, and this has been fostered by getting the engineering students to volunteer one or more hours of the week for instruction to laborers employed in adjacent plants. This instruction is either in the English language, in citizenship, or in athletics. A man who has volunteered for this work for a year or more, on going out into active life is a much more capable foreman than one who graduates from an engineering school and meets his first laborer somewhere on his new job.

Lately the National Americanization Committee of New York, of which Frank Trumbull, of the Chesapeake & Ohio Railroad, is chairman, has been conducting similar propaganda, sending to the various educational institutions of the country a proposed basis of a course on industrial engineering. The committee realized the importance of this in preparing engineering graduates for the problem of properly utilizing the man-power of the country. This proposed course goes into the scope of industrial engineering, describes the problem and the field; it takes up the question of the engineering insight of the work in reference to plant-building, its location, and the fundamental considerations in its construction; it takes up the management and division of the work, the analysis of the costs, and the machinery, and the materials, and the efficiency methods. It goes into the question of employment, management, and the methods for hiring, promoting, and transferring men. It also takes up industrial welfare with the various incentives to the workman and the provisions for his health and recreation, and for the vocational training of either himself or his children. It also gives instruction in that branch which is so often neglected, and that is conditions outside of the plant, the housing of the men, the planning of the town, and the health and recreation and eduction of their families. It takes up the problem of Americanization and what shall be done to make our melting-pot efficient, without dross, and finally it gives him instruction as to what has been done and what should be done in legislation.

You engineers who are college graduates should use your influence to see that courses in human engineering are introduced in your Alma Maters, if they are not already there. Do you mining engineers realize that your training and your experience, touching as it does on all branches of engineering, fits you better for broad and important work than those in almost any other profession? How many of you have been under the necessity

of developing a large mining property in some out of the way place, when everything came before you and nothing could be left to chance, where you had to see that your own town was built and provided with waterworks and sewers, lighting-plant, and schools? You had to develop a property in a place where nothing existed and you did not have a well-organized community to fall back upon with all these adjuncts provided. Only recently one of my former superintendents came into the office to tell me that he had given up a $12,000 per year position to take one with the Government for $3600. He did not hunt this Government job, it came after him. They asked him to go on to Washington and take a job in the Ordnance Department. They said that they had found that a mining engineer has had such varied experience, and has driven so little in ruts, that at a minute's notice he can jump from 6-in. projectiles to bailed hay.

The Chrome Industry

According to a statement by the U. S. Shipping Board, the Government is restricting importations of chromite from other countries than North, South, and Central America and the West Indies, in order to set free additional ships for the supreme military effort of the United States. There are, at the present time, considerable stocks of New Caledonian ore on hand and in transit, and, besides the domestic and Canadian supplies, new sources have recently been opened in Brazil and Cuba. Brazil is counted upon to produce 25,000 tons of ore in 1918, and a considerable tonnage is expected from one mine in Cuba which already has been partly developed and will be put into operation at once.

Estimates differ as to the amount of ore which can be produced in California and Washington, which are our principal sources of domestic supply; but every effort will be made by the Government to stimulate and encourage this production. In addition to this, however, much would depend upon the attitude of those concerned in the chrome industry, and upon the methods used by producers and consumers alike. It appears that the chrome industry in California is not organized, and that an immense amount of annoyance and detriment has been caused by middlemen who do not represent responsible operators and who come between the producer and the consumer in such a way as to discourage mining in many cases. In an attempt to correct this evil, the Electro-Metallurgical Co., the chief purchaser of chrome ores, has inserted an advertisement in many local Californian papers, stating their minimum ore prices on a basis of $1.25 per unit for 38% ore. Organized action by the Pacific Coast chrome industry would doubtless be effective in this and other matters. The War Industries Board and other departments in Washington, it is understood, will co-operate in stimulating production. This co-operation must also be extended by the Railroad Administration, and the discouraging effect of railroad embargoes must be removed if the shipping program is to be carried out. Several plants are being built on the Pacific Coast to manufacture ferro-chrome, but their chief difficulty has been in obtaining electrodes. It is to be hoped that this lack will soon be overcome in some way.

Concentration of low-grade ores must be undertaken if the expected requirements are to be met. With the increased prices for chromium, it is possible that the old Pennsylvania-Maryland chrome district may be able to produce some ore which can be concentrated to a workable product.

On the part of the consumers, great economies can be effected in the use of chromite, and are already being carried into effect. For example, about 40,000 tons of ore has been used annually for refractory linings in copper and steel-furnaces; but it has been ascertained recently, beyond any doubt, that 90% of this chromite can be substituted by magnesite, of which large supplies are available in Canada and Washington. As a matter of fact, these economies in the substitution of magnesite for chromite linings already have gone into effect to a large extent. Manufacturers are urged to practice this economy more extensively. The U. S. Bureau of Mines estimates that the maximum allotment of 12,000 to 15,000 tons for refractory purposes for 1918 will be ample, and from information obtained through manufacturers it would seem that this estimate is liberal and even may be diminished. Manufacturers of ferro-chrome may be obliged to use lower-grade ores than those to which they have been accustomed. This appears to be feasible from a metallurgical standpoint, as it will be simply a matter of adjustment of practice. Steel-makers can get along with a lower grade of ferro-chrome if it becomes necessary.

MOLYBDENUM ORE treated in 1917 at the concentrators of the International Molybdenum Co. at Renfrew, Renfrew Molybdenum Mines at Mount St. Patrick, and the Mines Department at Ottawa, Canada, amounted to 692 tons. From this ore 80,614 lb. of concentrate was produced, worth $108,501. The molybdenum contents of the concentrates varied from 52.9 to 93.5% MoS_2. From the plants of the International Molybdenum Co. at Orillia and the Tivani Electric Steel Co. at Belleville there was a production in 1917 of 149,000 lb. of ferro-molybdenum valued at $348,775.

GOLD production of India is fairly steady at approximately 600,000 oz. per annum. This metal (917 fine), prior to the War, was sent to England for refining, but it is now proposed to do this and coin sovereigns at Bombay. This is the nearest large city to the Kolar goldfield, State of Mysore, which contributes 90% of the total gold output.

ARSENIC is increasingly needed as an aid for protecting our food supply through its use as an insecticide and for killing weeds. The domestic output for 1917 was 6151 tons, representing 60% of the total consumption. The War Minerals Bill is hoped to stimulate production in this country.

Concentrates

RAWHIDE PINIONS economically and efficiently replaced those of brass and steel at the Braden mill in Chile.

IN DRILL-BITS, the distribution of work throughout the entire length of the cutting edge is essential for efficient drilling, which depends on skill in sharpening.

THE GREAT ENGINEERING FEATS of China are the Grand canal, the Hangchow bore, the Wall, the salt wells of Szechwan, and the irrigation system of Kwanhsien.

POWDER COSTS at the Homestake mine, South Dakota, in 1917, when 1,677,623 tons of ore was extracted and 19,320 ft. of development done, amounted to 17 cents per ton treated.

A QUINTAL weighs 100 Spanish pounds, in Chile equal to 46 kilogrammes, where it is used in reporting nitrate business. The Spanish pound weighs 460 grammes, or 1.0141 lb. avoirdupois.

CEMENT AND SAND—3 to 1 mixture—sprayed on mine timbers, by compressed air, renders them fire-resisting to a considerable degree. Any desired thickness may be built up by spraying in layers, by the cement gun.

A SMELTING-FURNACE is not a melting-furnace, from a metallurgical standpoint. In the former, ore and fluxes are reduced to matte or metal; in the latter, some metal is simply melted for casting into any desired shape.

CHOKED ROLLS and full ball-mills result in high torque in electric motors. At the Braden mill in Chile, where squirrel-cage induction motors form part of the power-plant, to start those ranging from 15 to 300 hp. directly on line voltage, it was found necessary to re-connect the auto-starters.

PITTING in steam-boiler plates may be filled by welding in metal by means of an oxy-acetylene jet. Some insurance companies will not pass such boilers, nor some State accident commissions. On curved plates this method is not advisable, but on flat sheets the risk of failure is less.

SADDLE-REEFS or veins of the Bendigo type, Victoria, are also worked at Westonia, Western Australia. In the Edna May mine the saddles follow each other in a horizontal series instead of vertically, as at Bendigo. One leg of the saddle turns on the greenstone foot-wall, the other striking across the gneiss.

THE PRINCIPAL ADVANTAGES of the electric furnace over other methods of making steel are: (1) It economically produces the highest temperature obtainable. (2) It offers a ready and easy means of exact temperature control. (3) Any temperature or treatment by slags is possible without contamination of the charge through gases and other impurities. (4) Fusion is effected in a perfectly neutral atmosphere. (5) More rapid steel melting can be accomplished with the electric furnace than with any other types available, according to T. R. Hay in 'The Iron Age.'

CHARCOAL precipitation of gold from cyanide solutions will probably come into extensive use in Australia, where zinc is difficult to secure, and is very costly. At the Yuanmi mine, Western Australia, H. R. Edmonds finds that, on a working scale, there is an advantage of 70% in cost by using charcoal compared with zinc-dust. The bullion is also of higher fineness.

COMPRESSED-AIR hoists, pumps, and drills are fast displacing steam-power in the Missouri-Kansas-Oklahoma zinc-lead region. As far as economy is concerned it has been demonstrated that with direct-connected gas-driven air-compressors the entire shaft-sinking equipment can be operated much more cheaply by air than with steam. The only reason that compressed air is not generally used is because proper precautions are not exercised to prevent engines and pumps freezing at the exhaust.

MANY SPECIES OF EUCALYPTUS TREES in Australia have a distinctive selection in habitat. Some prefer a silicious soil, others a basic soil, while many approach a common boundary, yet do not intermingle. In four related species the relative constancy of manganese in the ash is striking, amounting to 1 part in 1,000,000 parts of anhydrous timber. In five other species the manganese is 1 part in 60,000 parts of anhydrous timber. In the ash of the 'box' species—eucalyptus albens—the lime content is over 50%, and magnesia only 2%. Oil from the broad-leaf peppermint—eucalyptus dives—is the best of all essential oils for use in flotation. The yield from this tree is 3% of oil. The cheaper phellandrene eucalyptus oils act better in flotation than the more expensive oils from these trees.

SODIUM MANGANATE is now used on the Rand as a substitute for all purposes where refined potassium permanganate was used. The substitute is made locally by mixing 1 part by weight of 40% manganese ore to 1.44 parts of caustic soda; also 1 part of ore to 1.1 parts caustic soda, and 0.4 part nitre. The ore is ground so that 61.6% passes 200-mesh, with only 5.7% remaining on 60-mesh. The ore and soda are well mixed in 500-lb. charges, each being placed on the hearth of a four-deck muffle-furnace. No rabbling is necessary. The temperature is kept at 650 to 750°C. for two or three hours, yielding a product containing from 18.2 to 21.9% sodium manganate; but with an initial temperature of 450°C., gradually raised to 560°, and held there for 8 hours, and cooled for 4 hours, a 28% product is made. The compound should be placed in sealed containers to prevent decomposition. The loss in weight during heating is 12.5%. The reactions are:

Without nitre

$$3MnO_2 + 2NaOH = Na_2MnO_4 + Mn_2O_3 + H_2O$$

and with nitre

$$2KNO_3 + 2MnO_2 + 4NaOH = 2Na_2MnO_4 + 2KNO_2 + 2H_2O$$

Ore-Reserves of the Disseminated-Copper Mines

The reports of these companies for 1917 give the following estimates:

Mine	Tons	Copper, %
Chino Copper	95,555,843	1.656
Inspiration Con.	87,864,378	1.388
Miami Copper	48,760,000	1.581
Nevada Con.	70,025,322	1.580
Ray Con.	89,812,522	2.048
Ray Hercules*	9,500,000	1.770
Utah Copper	371,752,000	1.390

*Ray Hercules is a new mine, about to start milling.

The Disseminated Copper Mines in 1917

Essential results of the six great disseminated-copper mines of the United States are shown in the following table, which covers the past two years:

	Tons milled		Copper, %		Mill recovery, %		Cost per lb., cents		Price received, cents	
Mine	1917	1916	1917	1916	1917	1916	1917	1916	1917	1916
Chino	3,608,100	3,094,400	1.640	1.830	69.32	66.59	11.390	8.710	25.810	26.465
Inspiration Con.	3,891,075*	5,332,058	1.338	1.548	75.34	74.86	10.439	8.673	26.366	25.393
Miami	1,640,206*	1,842,017	2.032	2.070	69.25	73.88	12.510	9.520	23.871	24.465
Nevada Con.	4,064,095	3,922,634	1.462	1.632	73.08	73.87	11.680	8.860	25.850	25.830
Ray Con.	3,560,900	3,332,340	1.635	1.607	74.53	72.20	12.649	10.577	25.900	26.724
Utah Copper	12,542,000	10,994,000	1.337	1.435	61.10	62.34	10.995	6.950	24.186	26.139

*Operations curtailed by labor troubles.

Inspiration Mill Statistics, 1917

During 1917 the concentrator operated full time until July. From then until late in August it was out of commission, due to labor troubles. Full capacity was not reached again until March 1918.

Ore milled, dry tons	3,891,075.000
Per day of milling, tons	12,884.400
Average number of sections at work	13.756
Average rate per section, tons	936.700
Assay of mill-feed, copper, per cent	1.388
Screen analysis of feed to concentrating machines (on 48-mesh)	3.300
Copper oxide in mill-feed, per cent	0.279
Assay of general mill-tailing, per cent	0.355
Copper oxide in mill-tailing, per cent	0.237
Copper in concentrate produced (smelter assay), per cent	29.270
Copper in flotation concentrate, per cent	35.570
Copper in table concentrate, per cent	13.930
Moisture in general concentrate, per cent	17.200
Concentrate produced per ton of ore dressed, tons	0.036
Recovery of copper in milling calculated from assay only, per cent	75.340
Assays and weights of concentrate and ore, per cent	75.780
Assays and weights of concentrate and tailing, per cent	75.460
Assays and weights of ore and tailings, per cent	75.360
Recovery of copper sulphide in ore, per cent	89.730
	Gallons
Water used per ton of ore	348
Water consumption for first six months of year per ton ore milled:	
Reclaimed in tanks at foot of mill	356
Reclaimed in tailing-ponds	475
New water from Kiser pump-station	277
Total	1,108

Power used per ton of ore milled for first six months of year, in kilowatt-hours:

Coarse crushing	0.43
Fine grinding and concentrating	10.87
Blowers for flotation air	2.42
Filter and reclaiming water	2.01
Lights	0.07
Total	15.80
	Pounds
Steel-ball consumption in fine grinding, per ton of ore milled (for year)	1.82
Flotation oils per ton of ore milled:	
Coal-tar	1.21
Sundry oils	0.11
Total	1.32

A 200-ft. diameter concrete settling tank for tailing was constructed, and the filter plant was enlarged 50%.

Concentrating Zinc Ores at Butte

During 1917 the Butte & Superior Mining Co.'s mill was considerably improved, especially in the flotation department and tailing disposal arrangements. Although there was a period of re-adjustment, and a complete shut-down for six weeks on account of labor troubles, the mill recovery only dropped from 93.13 to 91.13% of the zinc content of the ore. The plant dressed 461,953 tons having the following assay and total metal contents:

	Zinc, %	Lead, %	Copper, %	Silver, oz.	Gold, oz.
Assay	15.4692	1.0913	0.1717	5.8003	0.00908
	Zinc, lb.	Lead, lb.	Copper, lb.	Silver, oz.	Gold, oz.
Contents	142,920,807	10,082,584	1,586,302	2,679,462	4196

The concentrating plant yielded 138,661 tons of zinc and 2543 tons of lead concentrates. These assayed as under:

Zinc concentrate:

Zinc, %	Lead, %	Copper, %	Silver, oz.	Gold, oz.
47.3636	3.3498	0.4705	17.8348	0.0277

Lead concentrate:

Lead, %	Zinc, %	Copper, %	Silver, oz.	Gold, oz.
35.5600	13.7540	0.2917	21.3620	0.0296

The metal contents of all concentrates was 132,036,735 lb. of zinc, 11,098,051 lb. of lead, 1,329,570 lb. of copper, 2,527,302 oz. of silver, and 3918 oz. of gold.

The direct cost of milling was $2.52 per ton of ore, an increase of 36%, due to abnormal conditions.

MACHINE-SHOPS on Rand mines have £718,090 ($3,450,000) invested in them. They employ 9366 people, who were paid £1,318,972 ($6,330,000) during 1916, and produced work valued at £2,654,147 ($12,740.000).



BUTTE, MONTANA

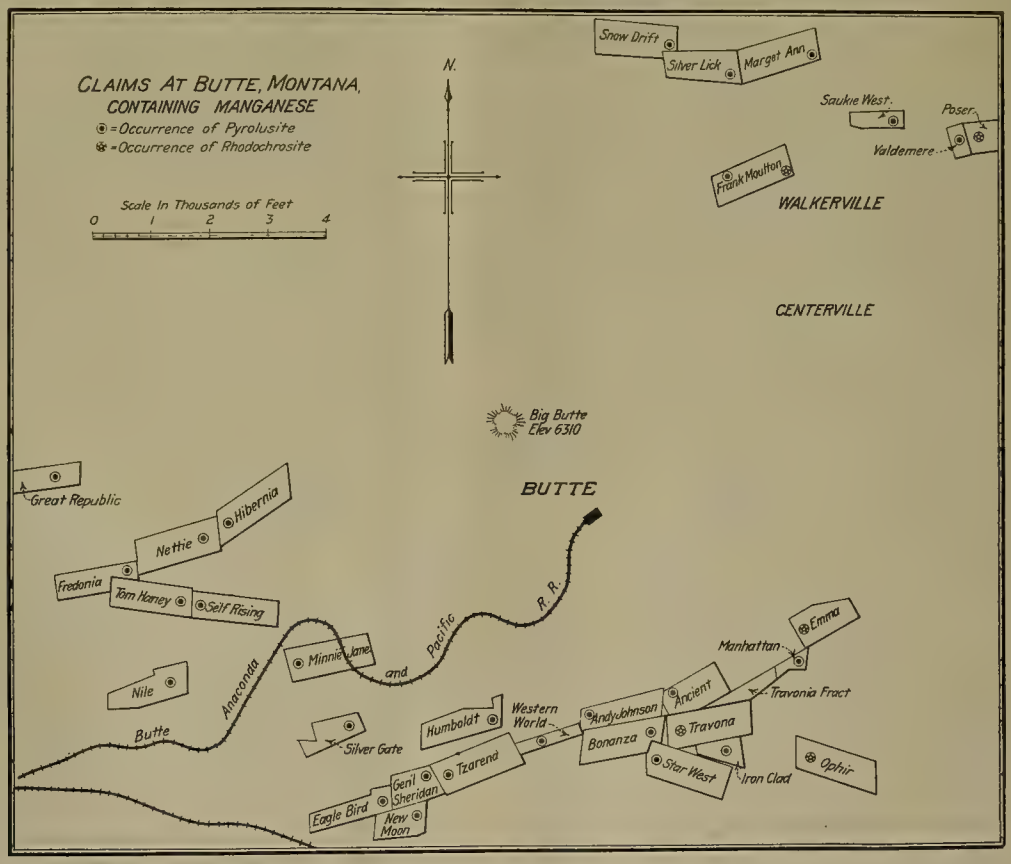
Resume of Manganese Possibilities at Butte.

'Manganese at Butte, Montana,' is the title of Bulletin 690-E, by J. T. Pardee of the U. S. Geological Survey. The manganiferous gangue of the silver-zinc lodes, formerly regarded as waste, is under present prices a possible source of considerable manganese. The smaller part of this material consists of manganese oxides in outcrops and upper portions of the lodes. Reserves of these are as follows:

Tons	Mn, %	SiO_2, %
26,000	40.0	10
132,000	24.0	50
270,000	11.5	73

It is possible that the second class can be concentrated. Most of the manganiferous material below the oxidized zone consists of rhodochrosite and rhodonite—the carbonate and silicate of manganese, respectively. The former mineral is fairly pure, that in the Emma mine carrying from 34 to 41% Mn and as low as 1% SiO_2. A light roast drives off carbon di-oxide, and increases the manganese content. Several thousand tons are available, and large additional quantities should be developed. The amount of 15% is estimated at several million tons. About half of the manganiferous zone at Butte lies north of the copper area and east of the rhyolite, the remainder in the south-west and west sections. The mineral is most abundant in the south-west part. Two main types of veins are found at Butte—the black or oxide ore of the outcrops and oxidized zone, and the pink or carbonate and silicate below. Most of the manganiferous lodes carry less than 40% Mn, and are high in silica, with 3 to 4% iron. Whether Butte can be counted upon to produce large quantities of manganese at an early date depends rather on ore-dressing problems than on mining.

Advice from Boston states that the United States Manganese Corporation has been chartered in Delaware with capital of 100,000 shares, 8% preferred, and 600,000 shares common, par value of both $10. The new company has acquired control of all manganese deposits at Butte and vicinity and practically all independent manganese concentration plants in Montana.



MANGANESE-BEARING CLAIMS AT BUTTE. (MAP RE-DRAWN FROM ORIGINAL PREPARED BY THE ANACONDA COMPANY.)

PLATTEVILLE, WISCONSIN

Zinc, Lead, and Pyrite Situation in May.

Zinc mines experienced numerous and distressing drawbacks during the first half of May. For a time it appeared that many companies would be compelled to suspend entirely until better conditions prevailed. Prices for ore dropped seriously and labor was short through young miners being drafted. Ore quotations dropped from $61 base to $50, with the range on second grades at one time as low as $40 per ton. On the lower grades required for the separators, usually averaging 30% zinc, prices fell as low as $16 to $18, a figure that producers declared was below cost of production. This branch of zinc mining suffered appreciably on this account, and many mines were shut-down with bins well filled with unsold concentrate until about mid-month. The surplus zinc ore in the field was conservatively estimated at 10,000 tons. The appointment of an allocation committee at Washington early in May began to bear fruit soon after, when the price for 60% ore was brought up to $75 per ton for all blende entering into rolled sheet metal. While this figure applied on a small quantity of high-grade offered for sale, it nevertheless inspired mining men with hope that other ore would receive better prices.

Production in the field shows a decided curtailment, about 60% of normal, while shipments to smelters also reveal lower tonnages. Mine development has been brought to halt at all points, also erection of mine equipment. Several independent mining corporations have been negotiating with stronger companies for a complete sale and transfer of their properties. They argue that high costs and low prices for ore are bound to continue indefinitely, and it is best to get out. In fact, it will cause no surprise to find that within the next six months mining in Wisconsin will be under control of the larger operating groups affiliated with or backed by the leading smelter interests, which they now supply with ore.

Lead-ore producers have not fared as well this month as was hoped, and sales were restricted to 3 cars each week for the first two weeks. Prices dropped from $85 for 80% ore to $80 per ton, with fluctuations in value raised or lowered $1 per unit. Sales scarcely covered current output, so that the reserve in the field figured at more than 2000 tons at the beginning of the month was not diminished. However, this was also little increased under the lower offerings, the lower prices for zinc ore resulting in a decreased output of this ore, which in turn is mainly responsible for recoveries of lead ore, the latter being mostly a by-product in wet concentration of zinc ore. New buying interests entered the field about mid-month but it was apparent buyers were after lead ore on consideration that current bids were acceptable, and where not to let the ore alone. Prices however were improved soon after this, the range being from $80 to $84; sales at the latter figure being made for delivery in the week of May 18.

Exceptional developments transpired in the production, sale, and shipment of iron pyrite, mainly used in the manufacture of sulphuric acid. Prices show no change, but as most of this grade of ore has been sold under contract no figures are available. The current weekly recoveries for the field, exclusively fine material obtained at separating plants in treating zinc concentrate, amounts to 800 tons. Shipments have been increased to 2500 tons in a single week, and for this month total more than 5000 tons, proving that considerable reserve ore has been worked off. The building of new acid plants in the field should stimulate output of pyritic ore, in the crude state, which acid-makers declare is better adapted to their requirements than the fines obtained at separating plants by magnetic-ore separation. The bulk of the pyrite sold so far this month has been going to the Grasselli Chemical Co., at Cleveland, Ohio.

VICTORIA, BRITISH COLUMBIA

Manganese, Molybdenite, and Tungsten.—The French Complex Ore Process.—Iron Ore.

Manganese is one of the minerals much in demand at present. British Columbia has some manganese, and one deposit near Kaslo is sufficiently promising to have induced American capitalists, reported to have their headquarters at Seattle, Washington, to acquire the rights of development from the owner, A. J. Curle. New equipment is being erected, and it is expected that production will commence this year. The output is intended for the United States, it being possible now to ship manganese out of Canada without restriction. This condition has been brought about, within the past few months, through the representations of Mr. Curle, supported by the Minister of Mines for the Province. The stand taken by the latter was that, while it was just and right that such Canadian resources should be available first to the British Empire for the manufacture of munitions and other war essentials, it should be possible for the owners of property, when the Imperial Munitions Board indicated that it did not require the ore, to ship either to the United States or any other of the Empire's allies. The reasonableness of this was recognized and consequently the embargo, which had existed ever since war broke out, was removed as far as the United States and France are concerned.

It may be said here that the same is true of molybdenite, against which was an export embargo. This no longer exists. There are known to be considerable bodies of this mineral in British Columbia, notably that on Alice arm, on the northern coast. This has not been exploited heretofore because of an unfortunate tangle over the title to the property, but is is likely that this difficulty soon will be overcome.

Tungsten, another of the ores from which the former embargo has been lifted, is found in this Province. There is one scheelite deposit in the Cariboo district, as yet undeveloped, but samples are of promising quality.

Legislation had been introduced to the British Columbia Legislature, the annual session of which recently adjourned, giving the Government power to guarantee the bonds of the French Complex Ore Reduction Co., Ltd., to the extent of another $25,000. The Province already has endorsed this company's issues up to $40,000. With this capital a plant has been erected at Fairview, B. C., near Nelson. It has been equipped specially for the handling of the peculiarly refractory zinc-lead ore of the Slocan district by the French electrolytic process. The cost of plant, however, so exhausted the company's finances that it was unable to enter into the custom business on such a scale as to defray overhead expenses and keep ahead, and it became necessary to close down. The position was aggravated by the fact that with the great rise in price of zinc and lead the Consolidated Mining & Smelting Co., the largest smelting concern in western Canada, was able to install an electrolytic plant at Trail and to reduce the silver, lead, and zinc ores of the district. Under these circumstances the French Complex Ore Reduction Co. was compelled to cease operation, but its management is looking forward to the time, which in its opinion seems to have practically arrived now, when the Consolidated company will be unable to pay the prices it has been giving, and when the French cheaper process will be able to prove itself. It is claimed for this process that it is capable of recovering from 90% up of the zinc content of these ores, and that it can be run at a profit when the quotation on zinc falls to 5c. per lb. or thereabout. The Government, having placed its credit behind the company in the first instance, has indicated, by the legislation referred to and which no doubt will be passed, that it is prepared to give the company and its process every chance to make good.

Since the above was written, authority was given by the

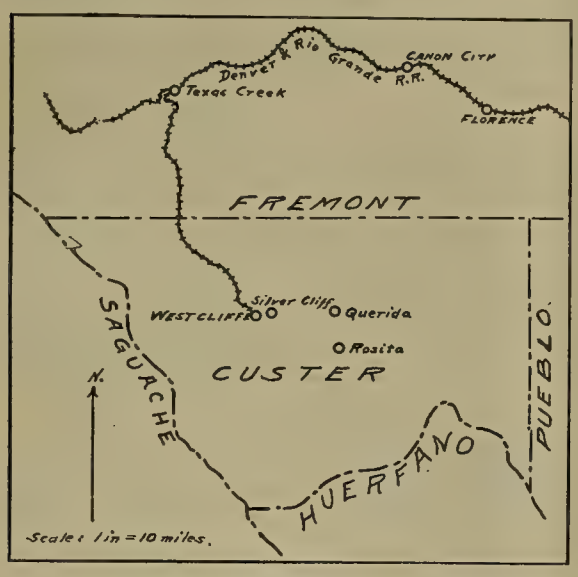
Legislature to advance the French company another $25,000.

In order to facilitate the important work of obtaining more knowledge of British Columbia's iron-ore resources, the Minister of Mines at the last session of the British Columbia Legislature obtained an amendment to that section of the Mineral Survey and Development Act, 1917, dealing with the drilling of mining properties. This Act gives the Minister power in diamond-drilling a claim or prospect, to place a charge against such property of the cost of the work, "together with a bonus equal to the total amount of the cost and interest at 6% per annum, computed annually." The amendment sets out that "in the case of iron mines, that is to say mines in which the iron recoverable from the ore is such that they are classed as iron mines by a resident engineer, no bonus shall be charged, and the amount payable to the Minister of Mines shall be the cost of the drilling or boring, with interest as aforesaid."

WESTCLIFFE, COLORADO

Mining Operations in Custer County..

Querida.—The Bassick mine has been taken over by the Bassick Mining & Reduction Co., under a long term lease, a company organized for the purpose by Harry S. Thayer



MINING DISTRICTS IN CUSTER COUNTY, COLORADO

of Boulder. A 100-ton flotation mill will be built at once to treat ore from both the mine and dumps. New hoisting machinery using crude oil for power will be substituted for the old steam plant. The Bassick mine was discovered in 1877, working continuously from that time until 1904 when the concentrator was burned. It produced many millions of dollars worth of gold and silver. Little has been done with it during the last 14 years on account of quarrels among the owners. The ore occurs as layers of metallic sulphides around the boulders in an andesitic agglomerate, which fills an old volcanic crater.

Rosita.—The Rosita Mining & Milling Co., under the management of Joseph Bradley, has taken over the Vernon, Leavenworth, Pioneer, Victoria, and Cymbeline claims. Work is being done at present through the Leavenworth tunnel, where a small but high-grade silver streak is being mined.

Hillside.—The Peerless copper mine has recently had an air-compressor put in; development is under way.

Westcliffe.—There is a great deal of activity in the White Hills district. The Passiflora Mining & Milling Co. is sinking its Herman shaft to the 330-ft. level. On account of the small capacity of the air-compressor this has necessitated a reduction in the amount of ore stoped and has curtailed shipments. There are half a dozen sets of lessees working on small blocks owned by this company, nearly all of whom are shipping regularly.——A 100-ton cyanide mill is being built on the King of the Carbonates to treat a large quantity of low-grade ore which has been developed on the property.——The Silver Bar mill is to be started soon on ore from the Quartz King and other claims.——George Shaeffer is making regular shipments from the Lady Franklin.——Preston & Beaman are operating the Black Friday, shipping a little high-grade ore.——The Bull Domingo Mining Co. has leased the old Bull Domingo mill, which now belongs to the Passiflora company, and is putting it in shape to concentrate Bull Domingo ore.——Development is being done on several of the copper claims in the Sangre de Cristo range south-west of town, including the Princess Annie and the Hermit Lake.

SUTTER CREEK, CALIFORNIA

Wage Increase.—Conditions at the Central Eureka.

As many men were leaving the county to get the better wages paid at copper and other mines, making the local mines short-handed, operators in Amador have raised wages of all underground employees 50c. per day, and in the majority of cases a 25c. increase to surface men, effective May 1. Miners, machine-men, and timber-men now receive $4, and car-men and shovelers $3.50 per day. At some of the mines where sinking is by contract, the men earn more, but the increased rate is already having an effect on the labor situation, men returning from centres where conditions are less favorable than here.

Sinking at the Central Eureka was suspended early in May, when the shaft had reached a point 135 ft. below the 3425-ft. level. For prospecting, a short cross-cut was then driven into the foot-wall from the sump, and ore was found of value enough to convince the management that the same character of rock exists at this depth as was worked so successfully on the 3350-ft. level, and slightly developed at 3425 ft. A station to be known as the 3500 ft. is now being cut above where this sump cross-cut was run, and while men are engaged in completing this and a shaft chute, others are cross-cutting from the station to open this orebody. Little work was done at 3425 ft. other than to determine the occurrence of pay-ore near the shaft, and no permanent station was cut, it being deemed more economical to work the ground between the 3350 and 3500-ft. levels from the new 3500-ft. workings. The recurrence of the vein in the bottom of the mine gives reason to expect good returns for money put into this property, notwithstanding the fact that the closing down of the neighboring South Eureka mine has saddled all the pumping expenses for the two properties on the Central Eureka. The latter has assumed charge of the pumps and hoisting eequipment at the South Eureka, the main pumps for the two mines being in that shaft. The burning out of a motor underground, together with necessary pump repairs, is necessitating the handling of water at the South Eureka by means of skips for a short time, but the plant is being rapidly put into more satisfactory condition. Twenty of the forty stamps at the Central Eureka have been dropping during shaft-sinking and recent development, but on account of labor shortage it may be difficult for some time to keep the mill fully supplied with ore. Prospects are good for the extraction of a fair quantity of pay-ore at minimum expense, though short handed, as the levels are being closely studied and worked systematically with this object in view. Since the resignation of Fred Jost, Albion Howe of San Francisco has been appointed superintendent, with Henry Warrington, assisistant, and William J. Bryant, mine foreman. George P. Harper of Martell has superseded A. W. Witte as mill foreman.

THE MINING SUMMARY

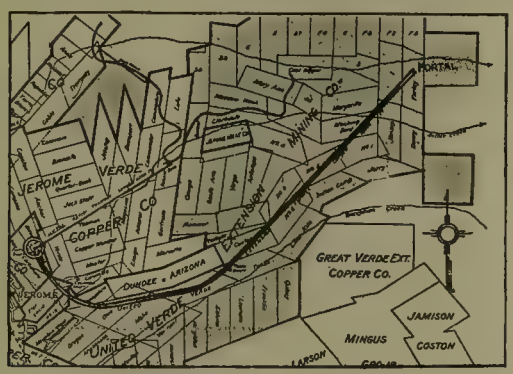
ALASKA

Juneau.—Alaska Gold Mines reports for the first quarter of 1918 that 469,695 tons of 98-cent ore was treated, of which 78.99% was recovered. Operations cost 80.7c. per ton, leaving a profit of 1.71c. per ton. The quarter resulted in a total loss of $8018. Labor was short, causing a decrease in tonnage of 680 per day when compared with the last quarter of 1917. In the December quarter there was a profit of $37,684.

ARIZONA

Ajo.—The New Cornelia company's main shaft is down 190 ft. It is to be sunk 250 ft. before driving south to the sulphide orebody is started. A new hoist has been erected. This is the first underground work on any scale that has been done in the district. Daily shipments of sulphide ore to the C. & A. smelter at Douglas are about 200 tons.

Jerome.—The United Verde Extension will take 9 months to complete its tunnel. The Potter Construction Co., which



PART OF JEROME DISTRICT, ARIZONA, SHOWING DIRECTION OF UNITED VERDE EXTENSION TUNNEL

had the contract for driving this opening, has been reorganized as Potter, Jarvis & O'Rourke. The work was described in this journal of April 27.

Water in the Dundee-Arizona is 30 ft. below the 450-ft. station, probably due to work in the Texas shaft section of the United Verde Extension tunnel.

On the 600-ft. level of Calumet & Jerome about 4500 ft. of lateral work has been done. Ground recently opened is of a promising character. The south cross-cut is in 1800 ft. from the shaft.

The Grand Island diamond-drill is down 908 ft., without cutting the lode exposed on 208-ft. level. Another hole will be driven. After passing the 700-ft. mark the bore passed through 30 ft. of jasper before entering a well-mineralized schist-zone.

Pittsburg-Jerome is driving two places on the 500-ft. and five on the 900-ft. level.

The Barter adit of Verde Squaw has opened good-looking ore.

Diamond-drilling on the 1045-ft. level of the Columbia shaft workings at the Jerome is disclosing some favorable formation.

Verde Combination shaft is down below 930 ft. in a soft blue schist carrying iron pyrite and chalcopyrite.

Oatman.—The Gold Ore has completed its first 30-day run at the Gold Road mill, having treated 1200 tons. Ore from the 700-ft. level is now being milled.

United Eastern in April produced 8000 tons of ore yielding $184,000.

The Oatman United shaft has reached the 400-ft. level, and driving east and west has been started.

Prescott.—The Ford Gold & Silver Mining Co. has been formed to take over and work the Promoter gold claims in the Crook Canyon district. The dump-ore is to be milled at once.

Ray.—Report of Ray Consolidated for the first quarter of 1918, compared with that of the last quarter of 1917, is as under:

	1st quarter 1918	4th quarter 1917
Ore milled, tons	878,200	893,800
Copper content, per cent	1.587	1.600
Recovery, per cent	73.60	73.74
Copper (including direct smelting), pounds	22,011,525	22,750,677
Cost of mining, per ton	$1.46	$1.24
Cost of milling, per ton	0.98	0.91
Cost of copper, cents per pound	15.307	13.836
Profit	$1,105,863	$2,570,872
Dividends paid	1,577,179	1,577,179
Deficit or surplus	−471,316	+993,693

CALIFORNIA

Cloverdale.—In the 'Press' of May 18 it was stated that the Western Minerals Co. was operating the Cloverdale mine, and that the ore averaged 10% quicksilver. This is incorrect, as it is the Western Mercury Co., and the grade is 0.5%.

Heroult.—Noble Electric Steel Co. has two furnaces making ferro-manganese at the rate of 500 tons per month.

Trinity Center.—The 40-stamp mill and 225-ton cyanide-plant at the Headlight mine are being dismantled. The mine has stood idle since October 1915, when it was found impossible longer to treat ore profitably by any known method, owing to the heavy sulphides in it. The mine belongs to the Trinity Gold Mining & Reduction Co. Ore worth $500,000 is said to be developed. The plant was run 18 months, from 90 to 100 men being employed.

Idria.—The New Idria Quicksilver Co. reports as follows for 1917:

The output of mercury was 11,000 flasks, an increase of 172. Shortage of labor hampered operations, while supplies increased 100% in cost. Another aerial tram, 3500 ft. long, to carry ore from No. 5 Idria level to the furnaces, was completed. The plant was improved considerably. The grade of ore was a little higher. Demand for quicksilver was good. Accounts are not clearly stated, but the 'gross income' of $410,774 was reduced to $146,771 after charging depletion and depreciation, also reserve for Federal taxes. Current assets total $477,675, and liabilities $298,705.

COLORADO

Blackhawk.—The Pittsburg mine is to be re-opened soon in charge of William Auger. Pumping has been continued during suspension of work. The Gilpin-Eureka mine here and the Gold Lode in the Russell district are yielding good gold ore.

Cripple Creek.—Diamond-drilling on the seventh level of the Cresson mine has shown 2 ft. of $92 ore, and farther on 12 ft. of $12 ore, according to the monthly report of Louis S. Noble, consulting engineer. Hole No. 36, driven to prove the discovery, showed 8 ft. of $101 ore about 10 ft. distant from the good-grade streak and also 5 ft. of $27 ore in another section.

The Vindicator flotation mill in this district treated 20,114 tons of $2.04 ore at a milling cost of 49c. per ton and net profit of 25c. per ton during April. The process is a combination of washing and flotation.

Eureka.—The Sunnyside company has been testing small units in the new flotation mill during the past few weeks. The plant will produce a large quantity of zinc concentrate during the season of 1918.

The D. L. & W. Mining & Reduction Co. has not commenced shipments yet, but soon will.

La Plata.—Mining in the La Plata is practically at a standstill. Small shipments have been made from the Idaho, Tippicanoe, and the Mountain Meadow mines.

Ouray.—The Hidden Treasure mine will be developed by E. P. Bauer. A few men are at work cleaning out tunnels. A large amount of ore is ready for shipment.

The Rare Metals Mining Co. has made application for a patent on the Black Dragon lode.

The Senorita has a car of ore ready to ship.

Gannon & Hall, new lessees on the Rose lode, have shipped their second car of ore.

There will be five mills in the Ironton mining district during the coming season. While present production is low, prospects for a busy year are encouraging. With the high price for silver, mines here can ship at a profit. Among the most important factors influencing local development is incorporation of the Ouray Consolidated Mining & Reduction Co., the name indicating its future activities. The company is about to erect a small laboratory, a concentrating unit, and a flotation machine at the smelter, in order to determine the lowest cost of dressing ores. A ball-mill is among the improvements. The smelter has immediate access to a large quantity of ore by aerial tram 3000 ft. long. It is proposed to develop this ore. In addition to the mill and smelter the company is to operate two mills. One of these is at Ironton, and will treat ores from the Keno, Indiana, Guadeloupe, and other mines in that district. This custom milling will be a great advantage to these mines. Machinery for the mill will be hauled and erected as soon as roads permit. After the Ironton mill is in operation the Treasury mill will be started. The operating cost of this mill is low, as it is driven by water-power. The National Bell and Guston mines will supply the Treasury mill, being operated under lease by the Ouray Con. M. & R. Co. The new venture should be successful, as there are numerous mines in the Ouray district carrying rich silver ore, but are highly silicious, and present transportation and treatment charges reduce profits considerably.

Camp Bird has cut a vein 22 ft. wide, assaying $30 per ton, to a point 10,800 ft. from the portal of the new tunnel.

Rico.—Fifty cars of ore was shipped from the district during April. The Rico Argentine continues to ship heavily to the Durango smelter.

Rico Wellington Mining Company reports for 1917 that it shipped 424 tons of copper ore, 1826 tons of lead-zinc ore, 709 tons of iron-sulphide ore, and 1687 tons of lead-silver ore, all dry weights. The net value of these was $105,589. Cash on hand at end of 1917 was $2395. The future of the property is considered good. Development is to be largely increased. A compressor and drills are being added. Reserves of 45% pyrite are said to be extensive.

Telluride.—The bonus system in effect in San Miguel county was discontinued on May 15, and a flat wage-scale adopted. Machine-men in drifts will get $4.75; machine-men in stopes, $4.50; timber-men, $4.50; timber-men helpers, trammers, shovelers, track-men, and miscellaneous mine labor, $4. Board at company houses will continue to be $1 per day. The companies concerned are the Tomboy Tramway & Tunnel, Liberty Bell, Primos Chemical, Colorado Superior, Belmont Wagner, Smuggler, Humboldt, and Tomboy.

IDAHO

Kellogg.—Caledonia Mining pays 3c. per share, equal to $78,150, on June 5.

Mackay.—The Empire Mines Co. is shipping 200 tons of 5.5% copper, 4 oz. silver, and $1 gold ore daily to Utah smelters. The lower levels are reported to show 12% ore. Another dividend may be paid in July. A 3-mile tram costing $125,000 has been erected, connecting mine and rail. Cost of haulage will be reduced from 60 to 12 cents. In charge of F. A. Behling there are employed 175 to 250 men.

Mullan.—At 2050 ft. depth in the Morning mine of the Federal company 10 ft. of good ore has been cut. This development adds largely to the mine's reserves.

Wallace.—Tamarack & Custer paid 3c. per share, equal to $53,287, on May 20. This makes $106,574 for the current year.

KANSAS

Baxter Springs.—Production of the district last week was 638 tons of blende and 116 tons of lead, valued at $30,140.

The Sunflower M. & M. Co., 7 miles west, is to erect a mill. Twenty drill-holes have shown 7.8 to 17.5% ore. H. B. Dooley is manager.

MICHIGAN

Houghton.—Copper Range pays $1.50 per share June 15. This makes $3 for the current year.

Hancock Consolidated Mining Co. reports as follows for 1917, through its superintendent, C. E. Weed: At No. 2 shaft, including 359 ft. of sinking, there was 7472 ft. of work done. No. 4 vein supplied 74.1% of the ore from this opening. Six electric locomotives—4 battery and 2 trolley type—are working on the No. 49, 53, 69, and 70 levels. At No. 7 shaft new work amounted to 2489 ft. For 8 months the ore was of good grade, thereafter it was poor, due to a 'bar' of waste 200 ft. wide. The mill stamped 302,725 tons of ore, averaging 13.223 lb. per ton (0.661%). The total yield was 4,005,882 lb. copper, an increase of 1,180,948 lb. The metal sold at 28.229c. per lb., realizing $1,142,454. Of this, $31,492 was profit. Current assets total $236,650, and liabilities $394,945.

The May copper production of the district is estimated at 18,000,000 pounds.

MISSOURI

Joplin.—Production of the region last week was 7508 tons blende, 43 tons calamine, and 1454 tons lead. These averaged $48, $30, and $83 per ton, respectively. The value was $486,381, making $9,575,581 for 20 weeks. Missouri contributed $114,577. The market is much livelier than of late.

Manhattan Zinc Co. is to erect a mill on a lease of the Cunningham estate, 7 miles north-west of this place. Twelve drill-holes show rich ore at a depth of 93 to 145 ft. B. M. Dougherty is manager.

MONTANA

Butte.—The High Ore mine of Anaconda has been closed for three months to permit of concreting the 3400-ft. shaft. This will cost $75,000. The High Ore produces 1950 tons of ore daily.

Butte & Superior started hoisting from No. 3 shaft on May 16. Repairs to the Black Rock shaft are progressing well. In regard to the suit by the Elm Orlu company over extra-lateral rights, Judge G. M. Bourquin has set October 21 for the supplemental hearing. This is considered of great importance to Butte & Superior.

Davis-Daly pays its initial dividend of 50c. per share, equal to $300,000, on June 20.

Report of Butte & Superior Mining Co. for the first quarter of 1918 shows that a profit of $327,982 was made, compared with $574,017 in the last quarter of 1917. The mill concentrated 135,877 tons of ore assaying 16.233% zinc and 6.346 oz. silver per ton. The mill recovery was 95.462%, an increase of 0.618%. Zinc in concentrate amounted to 42,112,311 lb. Costs dropped from $10.2759 per ton to $9.7374, this being in general charges, other departments rising.

Kendall.—Barnes-King Development Co. reports as follows for the first quarter of 1918: Gold returns and sundries totaled $450,283. Of this, $77,342 was profit. A dividend of $40,000 was paid. Another of equal amount was paid on May 15. The balance at December 31, 1917, was $232,247, and at March 31, 1918, $182,955. There was 17,761 tons of ore mined. Development costs were $2.08 per ton, a high charge; labor was unsatisfactory; and underground results were only fair. The April yield was $58,500.

NEVADA

Goodsprings.—Ore shipments from this district in April are estimated as 3350 tons.

Midas.—The Elko Prince Leasing Co. (John V. N. Dorr of New York, president, and Lee D. Dougan, general superintendent) operates the property of the Elko Prince Mining Co. at Midas. The leasing company was organized by the Dorr Cyanide Machinery Co. and its successor the Dorr Company, to finance the building of a mill and operate the property until all the money was repaid, together with some old indebtedness of the Elko Prince Mining Co. Upon liquidation of all debts a new contract was made whereby the Elko Prince Leasing Co. continues to operate mine and mill. About 50 men are employed.

Pioche.—Prince Consolidated has let a contract to Walter Fitch, Inc., to sink a 2-compartment shaft to 500 ft. This will be done by sinking from surface, and raising from the 300, 400, and 500-ft. levels already opened in the mine. This shaft will intersect the main incline at 500 ft. Litigation pending between the Prince Con., Virginia-Louise, and Davidson companies has been settled. The Davidson is now practically owned by the Prince. There was a counter apex-suit against the Virginia-Louise. The Prince has agreed to haul Virginia ores over its nine-mile railroad at 50c. per ton.

Sodaville.—Under this heading in the 'Press' of May 18 it was stated that certain people, including Mark Young, were developing tungsten claims here. Instead of Young it should have been E. T. Heggland.

Virginia City.—The threatened miners' strike was averted last week by an agreement being made whereby all underground workers and top carmen will receive $5 per shift during the period of the War.

NEW MEXICO

Deming.—The Republic M. & M. Co. shipped 14 cars of high-grade zinc ore to Philadelphia in April. O. Weiser is manager.

Santa Rita.—Chino Copper Co. reports as follows for the first quarter of 1918, compared with the last period of 1917:

	1st quarter 1918	4th quarter 1917
Overburden removed, cubic yards	833,241	858,653
Ore milled, tons	1,011,500	934,000
Copper content, per cent	1.6243	1.6388
Recovery, per cent	63.06	66.20
Copper production, pounds	20,721,217	20,266,715
Cost, cents per pound	15.28	13.65
Operating profit	$1,124,254	$2,282,167
Dividends paid	1,304,970	1,739,960
Deficit or surplus	−180,716	+ 542,207

A. L. Owens and others have taken lease and bond on Royal Memphis Mining Company's property in the Black range and will at once employ 30 men. A 100-ton plant includes a standard 4 by 5-ft. ball-mill, five Wilfleys, and four Joplin Risley tables. Ore contains zinc, lead, silver, and copper. Estimate of ore-reserves and probable is 75,000 tons. Shipments have been made to El Paso smelter.

OKLAHOMA

Miami.—The northern part of this district is receiving considerable attention now, and the Tulsa Metal, Green Mining, Miami-Douthat Mining, Western Mineral, and Grant-Walker companies are busy drilling or erecting plant.

Picher.—Production last week totaled 5543 tons of blende and 871 tons of lead, valued at $341,664.

OREGON

Gold Hill.—J. G. Davies of Sacramento, lessee of the Sylvanite gold mine, has purchased the electrically-driven 10-stamp mill formerly operated on the Gray Eagle mine north of Gold Hill on Sardine creek, and will place the equipment on the Sylvanite. This mine has been a steady producer of rich ore since the first of the year. The mill will treat the present output until contemplated development is completed, when a larger plant will be erected.

Harbor.—Theo. R. Heintz, manager for the Chetco Mining Co., operating the Mt. Emery gold mine 12 miles east of this place in Curry county, reports that operation has been suspended due to trouble in securing supplies, principally gasoline.

Rogue River.—Recent developments have uncovered a large deposit of 17 to 42% manganese ore 11 miles from this place on Evans creek. The property is under lease to M. S. Johnson of Gold Hill, who will ship some ore and dress the lower grade ore.

Selma.—Daily brothers and John Casey of Selma are operating chrome mines on the Illinois river.

SOUTH DAKOTA

Lead.—Tunnels for hydro-electric system of Homestake Mining Co. were driven in fast time last year, according to 'Engineering News-Record.' W. B. Arndt was contractor. Iron Creek tunnel is 1097 ft., and Long tunnel 3931 ft., plus a 17-ft. adit, a total of 5045 ft. Rock was medium hard limestone, save 200 ft. of hard flint. Tunnels are about 7 by 8 ft. over all. Work was conducted from 6 headings. Nine jack-hammers were used in drilling, air-pressure ranging from 90 to 120 lb. Usual layout was four 7-ft. cuts and ten 6-ft. side-holes. Cross-bits on ¾-in. hexagon steel and ⅞-in. 60% powder were used. In one period of 41 days, slightly over 1000 ft. was driven; in another of 23 days with 3 shifts, 350 ft.; and in another of 86 days, 1543 feet.

Rapid City.—South Dakota School of Mines 'Pahasapa' quarterly is a petroleum number. An unbiassed discussion of subjects pertaining to oil production was deemed necessary. Regarding oil and gas lands in Fall River county,

South Dakota, Le Roy Eastman discusses their development. In 1903 a large area was secured, and strong gas flows were encountered, but soon died down. In 1913 the Ardmore Oil Co. of Ardmore drilled 1400 ft., but the Dakota sandstone was not reached. In 1918 the company is now reorganizing, and may drill to 2200 ft. Ten miles southeast of Hot Springs two companies are to start drilling in the spring. North of Ardmore a company is down 1500 ft., while two others are down 300 to 650 ft. Well-marked structures in South Dakota are the Bad Lands, Erskine, Minnekahta, Teepe Creek, Slim Buttes, and Ardmore-Rumford.

TEXAS

Alpine.—The smelter that the Metal Products Co. is constructing here will be finished soon. It will receive ore from the mines of the upper border region of Texas. Later on, when conditions in Mexico are more settled, and the Kansas City, Mexico & Orient railroad is extended southwest to a connection with its line that runs from Chihuahua toward the Rio Grande, the new smelter will be able to handle much ore from the mines of that country. The plant will cost $125,000 and is intended as the first unit of a much larger one.

UTAH

Alta.—The Columbus-Rexall mine, which has produced 4500 tons of copper-silver ore netting $126,000, is estimated to contain 12,000 of ore worth $25 per ton. The company is free of debt, has $20,000 in its treasury, and has supplies worth $20,000. When roads permit, 30 tons daily will be sent to the smelters.

Gold Hill.—Western Utah Copper Co. report for 1917 shows an operating profit of $133,019, and net profit of $86,086. Earnings amounted to $471,478, and expenses $338,459. Current assets total $66,721, and liabilities $7556. The general manager, Duncan MacVichie, states that principal work and production was at the Gold Hill claims. Openings covered 5702 ft., on the 80, 110, 300, and 400-ft. levels. A good quantity of copper ore was exposed on the first two levels, some good silver-lead at 110 ft., and low-grade silver-lead on the lower levels. New equipment cost $47,592. During 10 months of 1917, 28,718 tons of 2.98% copper and 4.33-oz. silver ore, and 3305 tons of 5.62% lead and 7.98-oz. silver ore was shipped. This yielded 1,710,984 lb. copper, 371,418 lb. lead, 150,767 oz. silver, and 70 oz. gold.

Green River.—Needles Mining Co., 25 miles south-west, has shipped 600 tons of 40 to 52% manganese ore this year. An output of 400 tons per month is expected soon.

Park City.—It is proposed to consolidate 800 acres of mineral land in the Morgan belt, supposed to be the northern extension of the Park City ore-bearing zone. The properties involved are the Morgan-Crescent, Boston-Utah, and Iron King, which were controlled by G. T. Stenhouse.

Tintic.—Chief Consolidated reports for the first quarter of 1918 a profit of $276,826. Two 10-cent dividends have been paid this year, including one on May 6. Development covered 3231 ft. There was 16,668 tons of lead and zinc-lead ore mined, averaging $48.32 per ton. Cash on hand amounts to $419,915.

VIRGINIA

Richmond.—Possibilities for manganese ore on certain undeveloped tracts in Shenandoah valley, Virginia, are discussed in Bulletin 660-J of the U. S. Geological Survey, by D. F. Hewett, G. W. Stose, F. J. Katz, and H. D. Miser. North-western Virginia has been the source of much of the manganese ore mined in the United States, and has been the scene of active prospecting. In the belt investigated the well-known Crimora mine occupies a central position. The known manganese deposits in this part are masses of oxides associated with rocks of different types and have diverse structural relations. Some bodies are pure enough to be mined and shipped without preliminary treatment. Others are composed of nodules disseminated through clay, and must be washed before shipment. Rocks with which the ore is associated include sandstone, shale, limestone, and dolomite, and the older crystalline rocks on which these rest. Tract 1, near Elkton, has indications to suggest



NORTHERN VIRGINIA, SHOWING UNDEVELOPED MANGANESE AREAS

that further prospecting should be done on it. Tract 2 should be thoroughly prospected by drilling. In tract 3 prospecting should be confined to the area between Naked and another creek. Tract 4 is worthy of drilling and test-pits, also some work on No. 5 and 6 areas. These places are indicated on the accompanying map.

WASHINGTON

Chewelah.—The Northwest Magnesite Co. has placed a third kiln in commission, has a fourth ready for erection, and will construct two more. A coal-pulverizing plant is now at work. Powdered coal is used in place of fuel-oil.

Kiesling.—The Spokane Tin Mining Co. has developed good ore to a depth of 152 ft. A concentrator is to be erected. F. C. Bailey has an option on the mine, which is in Spokane county, for 3 years at $75,000.

Republic.—The Lone Pine Star-Surprise Consolidated Mining Co., operating the last Chance mine, is shipping 300 tons per week, according to Charles P. Robbins, general manager. This may be compared with 1000 tons per month early in the year. More than 1500 tons of ore is broken in stopes, against 1900 tons on April 1. A number of surface improvements are under way.

CANADA

British Columbia

Kaslo.—The Cork-Province Mining Co. has erected a ball-mill and flotation plant, costing $15,000. The mill will crush 75 tons in two shifts. The flotation unit will dress zinc-silver tailing. W. E. Zwisky is in charge.

Nelson.—Charles F. Caldwell, president of the Independent Mine Owners and Producers' Association of the Kootenai, is arranging a meeting of the Association for about June 1 at Nelson. Members of both the Provincial and Dominion parliaments are expected to attend. The Canadian Pacific Railroad Co. is said to be in sympathy with the owners and will probably be represented, making the meeting one of great interest and importance. Smelter rates and general subjects that the mine-owners must study will be considered.

Trail.—A significant notice was issued recently by the Consolidated Mining & Smelting Co. to its employees, as follows: "Large increases in the various items entering into the mining and smelting of the Rossland (B. C.) ores, such as wages, cost of explosives, coke, steel, general mine and smelter supplies, without adequate compensation in values by way of increased metal prices, coupled with increased taxation, has made it necessary for the company to suspend shipments from the Rossland mines indefinitely. An endeavor will be made to keep a small force on development work, and to place the remainder of our Rossland employees at the smelter, the Sullivan mine, Kimberley, and other lead-silver properties of the company." The explanation of the above is found in the fact that the Rossland ores contain but a few pounds of copper per ton, the value being mostly in gold. It is the intention, therefore, to make shipments just sufficient, with the augmentation of custom ore, to keep one copper furnace at Trail in operation. One of the company's officials put it succinctly when he said: "As a gold dollar will hardly buy half as much as before the War, there appears to be no great advantage in mining gold ores at this time, especially when almost every variety of mining cost has doubled and more."

Ontario

Cobalt.—Kerr Lake produced 201,000 oz. of silver in April. For the four months the output totals 816,894 oz., against 891,698 oz. in this period of 1917.

Nipissing produced silver worth $329,617 during April. This makes $1,240,230 for the current year, against $960,545 in the same period of 1917. The high-grade mill treated 210 tons and the low-grade plant 7023 tons.

Until more ore is blocked out the Temiskaming mill will be closed.

Kirkland Lake.—The Elliott-Kirkland company's shaft is down 515 ft. At 525 ft. a station will be cut and crosscutting started to the vein.

The Teck-Hughes mill treated 1969 tons of $5.86 ore during April.

Porcupine.—The Newray mine is now being developed by the McIntyre-Porcupine company under the new arrangement.

McIntyre-Porcupine company will pay a dividend of 5% on June 15, equal to $180,000.

Quebec

Amos.—The Indian Peninsula Mining Co. is to operate the molybdenite property of the St. Maurice Mines Co. in the Hurricanaw River district, near Amos on the transcontinental railroad. Frank Groch, W. E. Simpson, and P. G. Grant are largely interested. These shafts are to be sunk on the deposits.

The U. S. Bureau of Mines announces the following appointments:

C. H. Beal, petroleum technologist of the Bureau, who has been stationed at the Washington office for the past two years, has been transferred to the San Francisco station. He is to make an extended trip through the Mid-Continent field. **M. J. Gavin,** formerly chemist for the Shell Oil Co. of California, with headquarters at Oilfields, has recently received an appointment as assistant refinery engineer with the Bureau. **J. M. Wadsworth,** petroleum engineer for the Bureau, with headquarters at San Francisco, has returned from a two months' trip to Washington and other Eastern cities where he has been making fuel-tests for the Bureau. **E. W. Wagy,** petroleum technologist for the Bureau, with headquarters at San Francisco, spent March and April in Colorado and the Mid-Continent fields, co-operating with State officials in making investigations of the conditions of the wells in the Boulder field.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

G. L. Sheldon, of Ely, Nevada, is in Beaverhead county, Montana.

O. G. McKinney's address is desired by his sister, Mrs. L. J. Lassell, Kingman, Arizona.

J. H. McMichael, manager for El Potrero Mining Co., Sinaloa, Mexico, is in San Francisco.

A. G. McGregor, smelter construction engineer, left Lima, Peru, for the United States on May 2.

William S. Evans is now with the E. I. du Pont de Nemours & Co., at Wilmington, Delaware.

E. F. Gordon and **B. B. Boeircke,** of Boulder, Colorado, are examining mines in the Ely district, Nevada.

T. A. Rickard addressed the Utah section of the A. I. M. E. at Salt Lake City on May 29, his topic being 'Americanization.'

Maurice W. Summerhayes, former manager of the Porcupine Crown mine, is now manager for the Bluestone Copper Mining Co. in Nevada.

W. J. Trerise, formerly with the Morococha Mining Co., Peru, has been seriously wounded in Europe and honorably discharged as unfit for further service.

William C. Russell, who since the closing-down of the Caribou mine near Boulder has established an engineering office in Denver, is at present making oil-shale examinations in Garfield county, Colorado.

E. E. Vanderhoef, for the past ten years superintendent of steam-shovel operations of the Nevada Consolidated Copper Co., has accepted a position with the United Verde Copper Co. at Jerome, Arizona.

H. W. Morse, for the past five years with the Western Precipitation Co., has severed his connection to become technical manager for the American Trona Co., succeeding **C. P. Grimwood.** Mr. Morse will retain his official connection with the Western Precipitation Company.

Obituary

C. H. Rowland died at London on April 13 from wounds received at the battle of St. Quentin on March 22. He enlisted in the Royal Engineers in South Africa in 1915. Rowland was well known in South Africa, and at the time he enlisted he was superintendent of one of the large mines there. He leaves a widow and daughter.

F. R. Hutton, emeritus professor in Columbia University, and honorary secretary of the United Engineering Society, died at New York two weeks ago. He was known to a wide circle of engineers as the author of several standard treatises on mechanical engineering, particularly in connection with steam and gas-engines. In addition to other extensive publications he collaborated in the work of compilation for the Century Dictionary and the New International Encyclopedia. He was professor of engineering at Columbia from 1877 to 1907, and also served, in a consulting capacity, the Department of Water, Gas, and Electricity of the City of New York.

The U. S. Civil Service Commission announces an examination for the position of special agent to investigate general commercial and economic conditions in Mexico, Colombia, Venezuela, Bolivia, and Paraguay. The salary will not exceed $10 per diem and $4 for subsistence. Application forms and further information may be obtained from the secretary of the Twelfth Civil Service District, Room 241 Post-Office Bdg., San Francisco.

THE METAL MARKET



METAL PRICES

San Francisco, May 28

Aluminum-dust, large and small lots, cents per lb	65—70
Antimony (wholesale), cents per pound	15
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7¼— 8¼
Platinum, Government price, per ounce	$105
Quicksilver, per flask of 75 lb	$110
Spelter, cents per pound	9¼
Zinc-dust, cents per pound	17½

ORE PRICES

May 28

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38% and over, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton (nominal price)	$7.00—$8.00
Manganese, 40 to 50% Mn, Hazen, Nevada, cents per unit	92—110
Manganese, 48%, New York, per unit	$1.20
Molybdenite, per lb., 90% MoS_2	$1.25
Pyrite, domestic, New York, cents per unit of sulphur	28
Tungsten, 60% WO_3, California, per unit	$24

EASTERN METAL MARKET

(By wire from New York)

Up to the time of going to press our New York metal telegram had not arrived, but there have been no important changes in prices.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67c. for small lots, effective until June 1, 1918. Quotations in cents per pound are as under:

Date		Average week ending	
May 22	23.50	Apr. 16	23.50
" 23	23.50	" 23	23.50
" 24	23.50	" 30	23.50
" 25	23.50	May 7	23.50
" 26 Sunday		" 14	23.50
" 27	23.50	" 21	23.50
" 28	23.50	" 28	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	23.50	Oct.	28.50	23.50	....
May	29.02	31.69	....	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

The War Industries Board has recommended that the present price of 23½c. per lb. be continued for 3 months after June 1. The Shannon, Mass, Victoria, Lake, Franklin, Cuba, Nevada-Douglas, Ohio, Tennessee, and Adventure companies asked for a higher price on account of their steadily rising costs.

Copper production of the 'big four' mines in April, together with the first quarter's output and copper sold, is as under, in pounds:

Mine	April	First quarter 1918	Copper sold in quarter
Chino Copper	6,290,513	20,721,217	14,053,162
Nevada Con.	6,900,000	17,435,164	5,989,808
Ray Con.	7,350,000	22,750,677	12,502,877
Utah Copper	16,690,883	41,276,750	27,066,505

Nineteen of the largest producers in North and South America and Mexico yielded 138,614,112 lb. in April, while for 4 months they returned 540,482,289 lb., against 552,771,537 lb. in this period of 1917.

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to make prompt settlements with smelters and brokers, producers allow a discount from the Government price of $1, hence the lower price. The Government has not fixed the general market price at $1, but will pay this price for all silver purchased by it. The equivalent of dollar silver (1000 fine) in British currency is 46.85 pence per ounce (925 fine), calculated at the current rate of exchange.

Date	New York, cents	London, pence	Average week ending	
May 22	99.50	48.87	Apr. 16	93.73
" 23	99.50	48.87	" 23	97.35
" 24	99.50	48.87	" 30	99.66
" 25	99.50	48.87	May 7	99.52
" 26 Sunday			" 14	99.50
" 27	99.50	48.87	" 21	99.50
" 28	99.50	48.87	" 28	99.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	67.86	87.38	....
May	74.27	74.61	....	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

The price of silver in London is practically stabilized. The Shanghai exchange has eased somewhat, and is much below the parity with silver. Reserve of silver coin and bullion in India was 1044 lacs of rupees on April 7, 1259 lacs on the 15th, and 1169 lacs on the 22nd (the last figure is equal to $37,410,000). The German Reichsbank reports silver holdings of 120,000,000 marks ($30,000,000 normal), an increase of M104,000,000 ($26,000,000) in a year.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. On May 25, 1918, the Government fixed prices until September for grade A spelter at 12c. per lb. for itself and the open market. This grade constitutes only a small proportion of the total output. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c., and plate at 14c. per pound.

Date		Average week ending	
May 15	7.25	Apr. 9	7.23
" 16	7.37	" 16	7.00
" 17	7.37	" 23	7.00
" 18	7.50	" 30	6.88
" 19 Sunday		May 7	7.00
" 20	7.50	" 14	7.21
" 21	7.50	" 21	7.41

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	....	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

The zinc-ore market at Joplin, Mo., is better, especially for second grades. These sold for $43.50 to $45. Average for all grades last week was $47 per ton, basis of 60% metal.

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date		Average week ending	
May 15	6.90	Apr. 9	7.13
" 16	6.90	" 16	7.00
" 17	6.90	" 23	6.95
" 18	6.95	" 30	6.83
" 19 Sunday		May 7	6.72
" 20	6.95	" 14	6.73
" 21	6.95	" 21	6.92

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	....	Nov.	7.07	6.33	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

Cost of producing lead by the Bunker Hill & Sullivan last year was 6.64c. per lb. The average price realized was 8.73 cents.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date			
Apr. 30	115.00	May 14	110.00
May 7	110.00	" 21	110.00
		" 28	110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115.00	Oct.	78.20	102.00	....
May	90.00	104.00	....	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	....	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Mineral production of the United States, expressed in percentages of domestic demand (100%), as estimated by Director of the Geological Survey, is:

Antimony	10	Mica	38
Arsenic	60	Molybdenum	over 100
Chromium	37	Platinum	13
Corundum and emery	90	Potash	10
Graphite	25	Pyrite	33
Graphite, for crucibles	11	Sulphur	105
Magnesite	99	Tin	1½
Manganese	23	Tungsten	65
Mercury	120	Vanadium	over 100

Eastern Metal Market

New York, May 22.

Activity is moderate in all the markets, but there is a strong undertone in most of them.

Copper is fundamentally unchanged, pending a decision as to a future price.

Tin is extremely quiet, with offerings decidedly limited, and the price situation a little easier.

Lead is stronger, with the entire situation encouraging.

Zinc exhibits a firm tone, and is higher.

Antimony is quiet and unchanged.

In the steel industry it is evident that there is no escape from the fact that little steel can be had for ordinary consumption this year, if all the steel in the surprising total made up by the War Board can be supplied to ship, projectile, track, car, locomotive, structural, and other war uses in the specified delivery period. The month of May now promises to show the largest production in the past yearly period of both pig-iron and steel ingots. The most serious factor in the situation is the loss of three months' time in placing locomotive and car-orders. The Midvale Steel & Ordnance Co. is about to build and operate for the Government a great plant at Nicetown, Pennsylvania, to make 16-in. howitzers. Among the price adjustments announced on May 21 is an advance of $6 per ton on cast-iron water-pipe. In the labor situation the interesting fact is announced that the Midvale Steel & Ordnance Co. will take up the proposal to introduce women into its machine shops at Nicetown and its wire mills at Johnstown, Pennsylvania, to provide against a prospective shortage of men.

COPPER

A meeting, to which the entire copper trade is directing its attention, is being held in Washington today between the copper producers and the War Industries Board to discuss finally the price to obtain for copper after June 1. It is impossible to forecast any result of this meeting, which may last several days. All sorts of predictions are heard in the trade, many of which are conflicting, of course. It seems that the preponderance of opinion is that an advance will be decided upon, but how much is the question. A rumor is current to the effect that a compromise will make it 24.25c., or an advance of ¾c. per lb. over that which has obtained since last September. This compares with 25c. asked for or expected by some. The demand continues strong, with that for June nearly as large as that for May, with some difficulty ahead to supply it. Consumption is on a tremendous scale, with foreign demand recently on the increase. Bookings for delivery after June 1 are being made, with the price stipulated as the one ruling at that time, indicating an expected change. Exports are still small as compared with a year ago, those for April being reported as 21,528 gross tons, against 49,536 tons in April 1917. Each month thus far this year they have been less than in the same months a year ago. The total to May 1, 1918, has been 112,775 tons, as compared with 184,341 tons to May 1, 1917.

TIN

The market for future shipments is slightly easier, but offerings in general continue limited. In the last week, or since the last letter, there have been a few offerings of June-July shipment from the Straits which were readily sold, the price being about 93c. per lb. This is lower than sales made recently, which had been at 96 to 97c. The easier market, though limited in quantity, is due to a report that one steamer of Banca tin had been allowed to sail from Batavia, with others also about to sail. Nothing definite is known, however, and the Banca situation is up in the air, because on Monday another report came that the vessel had not actually sailed but was loading, and that some trouble about licenses was brewing. The spot market continues unrelieved. It is nominally quoted at $1.03 per lb., New York, with metal virtually unobtainable. Arrivals to May 16, inclusive, have been 800 tons at Atlantic ports, with 5000 estimated afloat. The London market is lower at £360 per ton for spot Straits, against £375 a week ago.

LEAD

The lead situation is more encouraging than in recent weeks, and the market has strengthened considerably in the last week. There have been fair sales, and a liberal inquiry from Canada. Buyers are coming into the market for small lots more numerously and also for some good sized ones. It is, however, reported as difficult to obtain prompt or May lead. Yesterday the market was quoted at 6.95 to 7c., New York, or 6.80 to 6.85c., St. Louis, for early delivery, with spot metal held at 7.25c., New York. The American Smelting & Refining Co. maintains its price at 7c., New York, unchanged for some weeks. The stronger technical position is due to the fact that the excess quantity that was being offered recently has been absorbed.

ZINC

The market has gathered strength, if anything, in the past week and the tone continues firm and cheerful. Prices have advanced, although inquiry and sales have not expanded, but rather have declined. The technical position is strong. The quotations on prime Western for early delivery are 7.25 to 7.37½c., St. Louis, or 7.50 to 7.62½c., New York. Sales have been made at the lower levels. For forward delivery there is less disposition to sell, despite some willingness to buy, and for these positions a premium of about ½c. per month is asked. There has been considerable interest manifested in the meetings that have been held recently in Washington relative to a fixed price of grade A which is effective to June 1. It is probable that a decision was reached not to change the present maximum price of 12c. per lb. for it is known that the Government has purchased quantities under this maximum. It is reported that 1000 tons of grade C was bought by the Government in the last week, but the price involved is not known publicly. April exports of zinc are returned as 7638 gross tons.

Sheet zinc is fixed officially at 15c. per lb. with 14c. as the price of plate zinc.

ANTIMONY

The market is unchanged at 12.50 to 12.75c., New York, duty paid, for Chinese and Japanese grades with the tone easier. The Government is reported to have bought recently about 1000 tons.

ORES

Antimony: There have been no developments and no business reported.

Manganese: As high as $1.35 per unit has been paid for Indian manganese ore for delivery in this country.

Molybdenum: There has been quite a little activity, with quotations $1.25 per pound of MoS_2 in 90% concentrates.

Tungsten: The market is firm at $24 per unit in 60% concentrates for both scheelite and wolframite and sales have been made at these prices. Lower grades have brought $20 to $23 per unit. It is stated that a hearing will be held at San Francisco in the week of June 24, when the U. S. Tariff Commission will discuss tungsten, quicksilver, and antimony. Price fixing in these minerals and metals will probably be postponed until after this.

Company Reports

Following are abstracts from the 1917 reports of the disseminated-copper companies:

CHINO COPPER CO.

Property: mines at Santa Rita and mill at Hurley, New Mexico.

Operating Officials: J. M. Sully, general manager; Horace Moses, superintendent of mines; F. R. Wicks, superintendent of mills; G. L. Webster, cashier.

Financial Statement: operating revenue was $19,261,306, less $9,434,690 for expenditures. Adding $310,436 miscellaneous income and deducting $624,198 for alterations, depreciation, etc., the profit was $9,512,854. Adding balance of $13,963,874 from 1916, there was available $23,476,728. After paying dividends there was carried forward to 1918 the sum of $14,863,926. Current assets total $10,962,576, a decrease of $225,767, and liabilities $8,829,255, a decrease of $876,325.

Dividends: four, equal to $9.90 per share, absorbed $8,612,802.

Development: the mining property was increased to 3010 acres during the year by acquiring 100 acres. Churn-drilling amounted to 22,425 ft., making 249,728 ft. to date. Overburden stripped by steam-shovels totaled 3,712,414 cu. yd., making a total of 20,599,199 cu. yd. Reserves of ore are estimated at 95,555,843 tons, averaging 1.656% copper.

Production: the mill concentrated 3,608,100 tons of 1.64% ore, equal to 9885 tons per day. This yielded 264,756 tons of 15.47% concentrate, which, with ore smelted direct, returned 83,339,782 lb. copper. This was a gain of 7,567,604 lb. over that in 1916. Two units were added to the mill, giving it a daily capacity of 11,000 tons. Another unit was built at the primary crushing plant at the mine, also a turbo-generator erected in the power-plant. In section 7 of the mill oxide and semi-oxide ore is to be treated.

Costs: These were as under, on a per ton basis:

	1917	1916
Steam-shovel operations	$0.5088	$0.3797
Milling	1.0300	0.6400
On a per pound basis:		
Total cost	0.1139	0.0870

INSPIRATION CONSOLIDATED COPPER CO.

Property: mines and mill of 20,000 tons daily capacity at Miami, Arizona.

Operating Official: C. E. Mills, general manager.

Financial Statement: sales of copper in 1917 realized $21,242,217. Expenses totaled $11,653,588 and depreciation $750,000, leaving a profit of $10,903,588, plus $177,144 for interest, equal to $11,080,732. Current assets are placed at $19,161,430, and current liabilities, $4,678,484. Balance from 1916 was $12,681,501, plus profit for 1917, making $23,762,233 available. After paying dividends the surplus carried to 1918 was $14,011,005. Federal taxes last year amounted to $1,185,249, already deducted.

Dividends: four of $2 each and a special of 25c., amounted to $9,751,228.

Development: 21.05 miles were driven underground, making 112.97 to date. During 1917, 22.73 miles of openings were destroyed, leaving 59.08 miles open at end of the year. No new ore was developed, so reserves are the same, less the amount mined, leaving 87,864,378 tons available. The average output per shift was 17.26 tons per man.

Production: from early in July to August 23, labor troubles resulted in a complete cessation. By March 1918 full capacity was attained. The concentrating plant dressed 3,891,075 tons of ore carrying 1.388% copper, of which 0.279% was in the form of oxide. Recovery of sulphide was 89.73%, reduced to 75.34% when calculating all copper. Concentrates produced 79,346,033 lb. copper, and oxide ore smelted direct 1,220,949 lb., making a total of 80,566,982 pounds.

Costs: these were as under:

Department	Per pound cents	Per ton
Mining	3.572	$0.7239
Coarse crushing	0.163	0.0329
Ore hauling	0.101	0.0206
Concentrating and royalty	2.931	0.5941
Concentrate freight	0.007	0.0015
Smelting, marketing, etc.	3.665	0.6369
Total	10.439	$2.0099

Mill statistics are given on page 764 of this issue.

MIAMI COPPER CO.

Property: mine and mill at Miami, Arizona.

Operating Officials: R. B. Gottsberger, general manager; F. W. Maclennan, assistant manager; F. W. Solomon, mill superintendent; R. B. Yerxa, assistant mill superintendent.

Financial Statement: during 1917 a profit of $4,952,137 was made. The revenue from metal sold was $9,009,152. Current assets, including metals $1,721,784, total $6,240,846, and current liabilities $1,187,565.

Dividends: four quarterly and one special, equal to $8.75 per share, totaled $6,537,247. Since 1912, $16,233,031 has been distributed.

Development: labor troubles resulted in a complete suspension for 7 weeks. New work amounted to 25,476 ft. On the Captain orebody 9406 ft. was done. A new extraction level—the 345 ft.—was opened to maintain tonnage. Shrinkage-stoping and caving are used here. In the eastern portion of the mine top-slicing is the method of mining. No. 2, or the 570-ft., haulage-level is open for the area being worked. A new shaft is being sunk, known as No. 5. No. 4 has been the only outlet for ore, and its crushing plant is overworked. The new shaft is being lined with concrete, and a crushing plant will be erected. With two such plants clean sulphide ore and oxide ore can be separated. Reserves of all classes total 48,760,000 tons, averaging 1.581% copper.

Production: re-modeling of the mill continues. Last year it concentrated 1,640,206 tons of 2.032% ore, yielding 53,639 tons of 43.04% product, containing 46,172,322 lb. Recovery was 69.25%.

Costs: these totaled 12.511c. per pound, against 9.520c. in 1916.

NEVADA CONSOLIDATED COPPER CO.

Property: mines at Ely, and mill and smelter at McGill, Nevada; also control of the Nevada Northern Railway Co.

Operating Officials: C. B. Lakenan, general manager; W. S. Larsh, underground superintendent; E. E. Vanderhoef, shovel-pit superintendent; G. C. Riser, concentrator superintendent; R. E. H. Pomeroy, smelter superintendent; C. V. Jenkins, business manager. (Mr. Vanderhoef recently resigned.)

Financial Statement: sales of ore and metals in 1917 realized $20,279,723. Operations cost $11,635,375. With income from other sources and balance from 1916 there was available $22,291,242. Dividends, ore extinguishment, alterations, etc., left a balance of $13,180,526. The year's profit of $9,408,893 was $6,026,467 lower than in 1916. Current assets total $16,834,891, and liabilities $2,533,468.

Dividends: these totaled $8,297,747, making $35,771,603 to the end of 1917.

Development: churn-drilling—67 holes—to an average depth of 417 ft. totaled 27,902 ft. Drills at Copper Flat showed 6,355,726 tons additional ore, assaying 1.457%; while at the Ruth mine reserves were decreased by 256,072 tons of 2.25% ore. Reserves at the end of 1917 totaled

70,025,322 tons, averaging 1.58%; plus 864,199 tons of 2.02 to 3.89% at the Kimbley, Wedge, and Veteran mines; also 174,648 tons of 2.5% carbonate ore used as flux. Steam-shovels stripped 2,998,025 cu. yd. of overburden. The Ruth mine is now equipped to hoist 4000 tons daily. Last year it contributed 32% of the total ore mined. Improvements at the mines included a new steam-shovel, locomotives, cars, hoist, compressor, and pumps.

Production: improvements to the mill were completed during the year. There was concentrated 4,064,095 tons of 1.462% ore, of which 73.08% was recovered. Concentrate assayed 7.673%. For the Consolidated Coppermines Co. the company handled 175,424 tons averaging 1.36%. Twenty-four roasting-furnaces were worked, an increase of two. They are all fitted to use coal in place of oil, as were also the reverberatory furnaces. The converters yielded 82,040,508 lb. copper, against 90,735,287 lb. in 1916. In the power-plant, a 3000-kw. turbo-generator, 20,000-cu. ft. turbo-blower, and triple-expansion pumping-engine are being installed.

Costs: a comparison of the past two years follows; per ton:

	1917	1916
Steam-shovel mining (less taxes), cents..	18.90	12.42
Steam-shovel mining (all charges), cents.	63.38	53.70
Ruth underground (direct charge).....	$1.0251	$1.2021
Ruth underground (all charges).....	1.3751	.....
Milling, cents	74.80	55.90
All costs, cents per lb. of copper.....	10.84	8.13

RAY CONSOLIDATED COPPER CO.

Property: mine at Ray, mill and smelter at Hayden, Arizona; also control of the Ray & Gila Valley Railroad.

Operating Officials: L. S. Cates, general manager; W. S. Boyd, superintendent of mines; D. D. Moffat, superintendent of mills; R. I. Ezell, cashier.

Financial Statement: operating revenue in 1917 was $21,278,071, and expenditure $11,299,415, leaving $9,978,656 net. Adding miscellaneous income and deducting alterations and adjustments the surplus was $9,701,170. The year started with a balance of $13,813,178, ending with $16,890,196. Current assets total $13,045,764, an increase of $2,044,466, and liabilities $1,878,547, an increase of $571,741.

Dividends: $4.20 per share, totaling $6,624,152 in 1917.

Development: general conditions at the property were never better than at present. At No. 1 shaft new work covered 35,617 ft., at No. 2, 48,069, and at No. 3, 1229 ft. There are still intact about 60 miles of workings. Most of the work was on No. 3 level, to open the lower portion of the orebody. Owing to decomposed schist, the main tunnel for 1620 ft., station, and pocket were concreted. Reserves are 89,812,522 tons, averaging 2.048%.

Production: improvements at the plant were mostly devoted to dressing the fine material made by milling. There was concentrated 3,560,900 tons of 1.635% ore, making 16,782,600 tons of 1.678% to date. Concentrate averaged 24.37%. Recovery was 74.53%, against 72.20% in 1916, and 64.11% in 1915. The sulphide ore gave 83.32%, and the oxide 33.48%. Including ore smelted direct, the output was 92,207,356 lb., an increase of 18%.

Costs: mining cost $1.04, which is 35c. higher than in 1916; coarse crushing, 4.66c.; milling, 82.86c. against 55.35c.; and all charges 12.229c., compared with 10.267c. in the previous year, per pound of copper.

UTAH COPPER CO.

Property: mines at Bingham and mills at Garfield, Utah; also control of the Bingham & Garfield Railway Co.

Operating Officials: R. C. Gemmell, general manager; J. D. Shilling, superintendent of mines; H. C. Goodrich, chief engineer of mines; F. G. Janney, general superintendent of mills; T. A. Janney, superintendent of Arthur mill; H. C. Smith, superintendent of Magna mill; C. F. Jennings, assistant purchasing agent; J. M. Hayes, treasurer.

Financial Statement: metals sold realized $48,797,423. Operations cost $24,886,646. Other income totaled $6,074,348, less $1,289,630 for alterations, etc. Adding the balance of $43,153,137 from 1916, there was available $71,848,633. After paying dividend the balance to 1918 was $48,293,528. Current assets total $38,340,361, an increase of $4,834,029; and liabilities, $8,054,471, a gain of $4,694,450. Book value of investments is $12,604.002.

Dividends: five disbursements amounting to $14.50 per share totaled $23,555,105, making $75,770,883 to date.

Development: churn-drilling in 11 holes totaled 8040 ft. So far, 105 holes have been put down an average of 597 ft. Capping removed amounted to 4,271,868 cu. yd. The area actually stripped is 121 acres. Reserves are now 371,752,000 tons, averaging 1.39%. All concentrating ore was mined by steam-shovels. From the Sulphide mine there was extracted 38,708 tons of copper-lead-zinc ore.

Production: considerable improvements were made at the Arthur and Magna mills, including the fine-grinding department and new leaching plant. The average normal and metallurgical-economic capacity is 24,000 tons daily, but they were crowded to handle 34,362 tons. Both mills dressed a total of 12,542,000 tons, compared with 10,994,000 tons in 1916, 8,494,300 tons in 1915, and 6,470,166 tons in 1914. The average grade was 1.337%, and recovery 61.1%, both decreases. Copper from all sources amounted to 206,174,442 lb., a gain of 9,756,962 pounds.

Costs: mining, transportation, and milling rose to $1.4170 per ton from 93.55c. in 1916 and 86.24c. in 1915; on a per pound basis the increase was from 6.95 to 10.995 cents.

The railway carried 34,653 tons daily, also 1838 passengers per day.

ALASKA JUNEAU GOLD MINING CO.

Property: mine and mill at Juneau, Alaska.

Operating Official: P. R. Bradley, general superintendent.

Financial Statement: the cash indebtedness, less the cash assets, was $1,124,101 on March 1, 1918. Including $459,359 from bullion and concentrate, the revenue in 1917 totaled $490,049. Expenses, including taxes, interest, etc., were $710,623. Expenditure on property and plant last year was $806,314, making $4,195,434 to date.

Development: in recent issues of the 'Press' the physical condition of the mine and plant has been fully discussed, so it is not necessary to cover the same ground again. A total of 23,741 ft. of development was done during 1917, making 76,063 ft. to date. The new work was confined chiefly to the north orebody along its westerly strike. This portion of the vein is more distant from the Silver Bow fault, and is not influenced by it. All samples from it show a good consistent average. The evidence now indicates existence of a large body in this section of the mine that will be free from large intrusions of waste, and will have a much higher recovery value than the mixed ore and waste now being drawn from the 400 stope. 'Muck' sampling to date from the entire mine—5303 samples—gave an average of 88.7c. per ton, and 409 moil samples since 1912 averaged $1.64 per ton. No. 4 level—400 stope—yielded 91% of the tonnage last year.

Production: part of the new mill started in April 1917, but many troubles, already described in this journal, curtailed reduction seriously. There was treated 672,424 tons of ore assaying 87.5 cents per ton. Of this value, 33.88c. was free gold, and 31c. in galena concentrate. Extraction was 74.15%. Since 1914, inclusive, the old and new mills treated 1,092,455 tons of $1.0095 ore. Extensive alterations are being made to the mill.

Costs: operations in 1917 cost $1.1556 per ton, including 30.12c. for preparatory mining, 11.62c. for bulldozing, 43.87c. for crushing, and 5.3c. for concentrating.

Book Review

The Principles of Economic Geology. By William Harvey Emmons. P. XVIII, 606; ill., index. McGraw-Hill Book Co., Inc., New York, 1918. For sale by 'Mining and Scientific Press.' Price, $4.

The need of a treatise on the recognized principles of ore deposition, and the criteria for judging the probabilities of the existence of ore from surficial indications, as well as the interpretation of the facts revealed by development with reference to the persistence and extent of orebodies, has long been felt. Probably no single geologist is better equipped to meet this want than Mr. Emmons. His perspicacity as an observer is well known, and he possesses the faculty of lucid exposition in a rare degree. These qualities, combined with his wide acquaintance with the ore deposits of this country, have resulted in a notable contribution to the literature of economic geology, admirably supplementing the splendid work of Lindgren. It is re-assuring in the beginning to note that he has not essayed an elaborate classification of ore deposits. He limits himself instead to a discussion of the features of the leading types as universally recognized. These are indicated by chapter headings that embrace deposits formed by magmatic segregation, pegmatite deposits, contact-metamorphic deposits, those of the deep-vein zone, those formed by hot solutions at moderate depth and also at shallow depth, those formed at moderate and at shallow depths by cold solutions, and finally sedimentary deposits. In developing his subject in accord with the results of modern research he has presented material of special importance to the student in his discussion of primary ore-shoots, the deformation of ore-shoots, faulting and folding of ore deposits, dynamic metamorphism of ore deposits, superficial alteration and enrichment, openings in rocks, structural features of openings in rocks and of epigenetic deposits, metasomatic processes, mineral associations in veins and wall-rock alteration, metallogenic provinces and epochs, and the composition and sources of ascending thermal metalliferous waters. These chapters comprise 283 pages of the book. They are followed by specific accounts of the habits of deposits of iron, copper, gold, silver, zinc, lead, the minor metals, and also the deposits of the more important non-metallic minerals. The volume is one that no mining engineer or geologist can afford to ignore. Exception may be taken to some details in any book on this topic, for we still have so much to learn that many problems in ore formation remain in the realm of controversy, but it is fair to say that few men could produce a treatise that would approach this in breadth of scholarship and in soundness of critical judgment upon the data of geology. We venture to suggest, however, that the significance of the pegmatites in their relation to the genesis of ores has not been fully elaborated. Perhaps this is because the phenomena of the pegmatites have not yet received the attention that they deserve. The good work of Brögger has not been extended greatly by our geologists, and it would appear that a field exists here to which the Geological Survey might well devote some of its talent for more prolonged investigation. We feel too that Mr. Emmons has slighted the discussion of the magma. In so doing he has kept apart from debatable aspects of magmatic segregation, but even in a textbook some boldness of statement might be forgiven for the sake of a broader treatment of one of the fundamental agents in producing so wide a range of the greatest metalliferous deposits in the world. He has drawn but little upon the illuminating contributions of Daly to this subject, and the student will obtain only a slight impression of the theories relating to the origin and intrusion of igneous rocks from this volume. In our view, the invasion and differentiation of magmas, and the effects from resorption of superincumbent rocks, constitute features of such profound significance in their relation to the formation of ores that an exposition of this phase of the subject should properly form a part of any work on economic geology. Mr. Emmons (pp. 170 and 220) seems to discard the possibility of the transference of ions through sub-capillary openings in the process of replacement, and while definitely stating that water does not obey the ordinary laws of hydrostatics through capillary channels, he says that "rocks containing sub-capillary openings may be replaced by solutions that are under sufficient pressure at high temperature." This is a contradiction in terms. We believe that a statement of the theories of molecular replacement, even when the water that holds the ionized salts in solution remains, as he correctly affirms, "as if fixed to the walls" of the sub-capillary opening, would have been desirable. These objections are made in a constructive spirit, for the work has been so well done as to merit the highest praise. The index, as in many technical works issued by the McGraw-Hill Book Co., is quite inadequate, thus lessening the facility with which it may be used as a handbook. Mr. Emmons has compensated for this, in a measure, by his admirable resumés at the beginning of each chapter. The illustrations are abundant and interpretative of the text. In one case, however, we note that Fig. 113 and 114 are reversed, which might prove confusing to a student. We would be glad to see an expansion of the treatment of surficial indications of ore deposits, in a subsequent edition. Mr. Emmons is specially well qualified to deal with this subject more extensively than he has done in the volume before us. It would be of the highest utility, since the geologist of the future will be called upon with increasing frequency to interpret obscure surficial signs in the search for ores. C. De K.

Recent Publications

The following are arranged according to the minerals discussed:

Carnotite

Mining and Concentration of Carnotite Ores. By Karl L. Kithil and John A. Davis. Bull. 103, Mineral Technology 11, U. S. Bureau of Mines, 1917.

Coal

America's Coal Problem in 1918. By H. A. Garfield. No. 23 of U. S. Fuel Administration, 1918. Pp. 7.

Zone System for the Distribution of Bituminous Coal. Publication No. 21, U. S. Fuel Administration, Washington, 1918. Pp. 28.

Firing Bituminous Coals in Large House-Heating Boilers. By S. B. Flagg. Paper 180, U. S. Bureau of Mines, Washington, 1917. Pp. 19, illustrated.

Cannel Coal in the United States. By G. H. Ashley. Bull 659, U. S. Geological Survey, Washington, 1918. Pp. 127, ill., index.

Effects of Moisture on the Spontaneous Heating of Stored Coal. By S. H. Katz and H. C. Porter. Technical Paper 172, U. S. Bureau of Mines, 1917. Pp. 23. Illustrated.

Percentage of Extraction of Bituminous Coal with Special Reference to Illinois Conditions. By C. M. Young. Bull. 100, University of Illinois Engineering Experiment Station, 1917. Pp. 173, ill., index.

Manganese

Manganese at Butte. By J. T. Pardee. Bull. 690-E, U. S. Geological Survey, 1918. Pp. 20.

Oil

Oil-Storage Tanks and Reservoirs. By C. P. Bowie. Bull. 155, Petroleum Technology 41. U. S. Bureau of Mines, 1918.



INFORMATION FURNISHED BY MANUFACTURERS

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WESTINGHOUSE EMPLOYEES RAISE TWO MILLIONS

A total of $2,144,800 subscribed by employees was the record of a 10 days' Liberty Loan campaign in the organization of the Westinghouse Electric & Manufacturing Co., with 30,384 subscribers from the company's plants and district offices. Mass-meetings at the noon hour addressed by four-minute speakers recruited from the shop employees, were an important feature of the campaign. At one such meeting, held at East Pittsburgh works, several thousand people listened to Sousa's band, and were addressed by Maj. Watt of the Gordon Highlanders. The Westinghouse and Scotch Kilties bands played at other meetings. Due to the enthusiasm and particularly to the efforts of the campaign committees, many departments were able to display '100 per cent' signs. About 1200 of the women employees marched in the Liberty Loan parade in Pittsburgh on April 20, carrying banners designating their work. They were accompanied by brass and bagpipe bands.

A re-organization of the Denver Fire Clay Co. has just been effected as a result of the purchase of the entire interest held by Willis W. Case Jr., by Mrs. Leonard Bosworth, wife of the founder of the business, and her three sons, Arthur H., senior member of the firm of Bosworth, Chanute & Co., of Denver; Harold O., of New York; and Capt. Robert B., an attorney of Denver, now in the service of the United States in France. Practically all of the stock has been held by the Bosworth family and Mr. Case for many years. The company was founded in 1876, and has developed into one of the largest concerns of its kind in the country. It specializes in clay products for assaying and other metallurgical work. Its technical staff has had many years experience in the blending of the fire clays which the company owns near Golden, and which are well known for their high refractory qualities. As importers and exporters of all kinds of chemicals for laboratory and industrial purposes and of scientific apparatus, it has customers in every nation in the world except those with which the United States is now at war. With the retirement of Mr. Case, Harold Otis Bosworth, who was formerly active with the Denver Fire Clay Co. for 10 years, but has of late been manager for the White Tar Co. of New York, will become president. J. Claire Evans, manager of the assay department of the Mine & Smelter Supply Co., will become vice-president. Herman Landenberger, who has been connected with the company for 20 years, will retain his present position as secretary and treasurer. George W. Lindsay, who has had considerable experience in the designing and construction of oil-burning appliances, will be the factory superintendent.

Babcock & Wilcox boilers will be built in Spain by a new corporation established at Bilbao under the title Sociedad Española de Construcciones Babcock & Wilcox. The new concern possesses close relations to the great Spanish iron and steel company known as the Altos Hornos de Vizcaya, which has taken a large block of stock in the enterprise. The leading capitalists subscribing to the stock, which amounts to 20,000,000 pesetas or approximately $4,000,000, are Ernesto de Ugalde, Fernando M. de Ibarra, Aldama y Cia., José L. de Oriol, and César de la Mora. The engineer in chief is Juan Urrutia, who is also a large stockholder. The shops to be established, as a virtual extension of the large iron and steel works already mentioned, will be the largest in Spain, occupying 32 acres, and will employ 2000 laborers. In addition to boilers, the company will make electric cranes and machinery for excavating and handling materials. The general office in Spain of the Babcock & Wilcox company is at Ventura de la Vega 1, Madrid.

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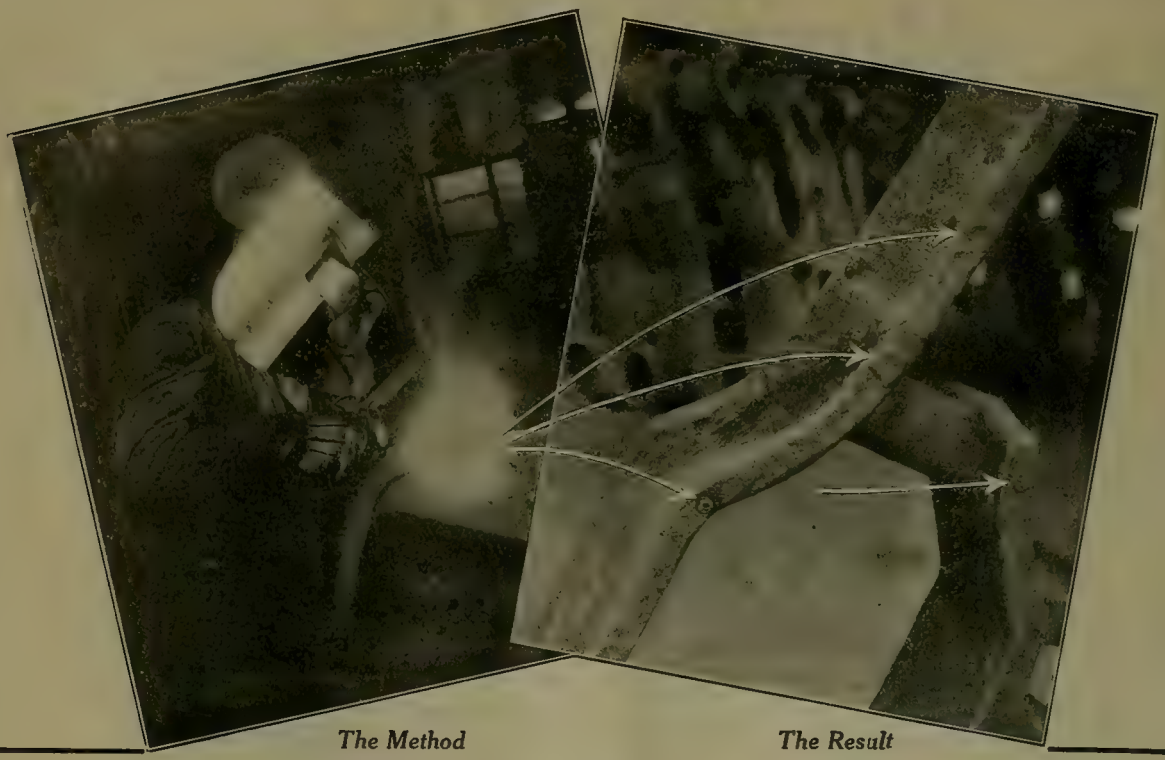
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THE Department of the Interior has evidently overlooked the fact that the Director General of Railroads is endeavoring to curtail tourist travel, judging by Newspaper Bulletin No. 113, extolling the beauties of the Zion National Monument in Utah, and the marvels of the Yellowstone Park and Crater Lake. Such advertising seems superfluous and out of keeping with the grave problems of war that confront us, as well as being a waste of clerical effort, of good paper, and of overcrowded postal facilities.

ACCEPTANCE of the principle of a maximum base price is involved in the agreement between the War Industries Board and the producers of aluminum, in accord with which the highest price, beginning with June 1, will be 33 cents per pound in lots of 50 tons or more of ingot assaying 98 to 99% pure. The arrangement as made will endure for three months. The differentials for sheet, rod, and wire will be increased approximately 12½%, while differentials for quantity and grade, and those for alloy, will remain as approved by the Board in March.

RAILROAD rates are to be increased 25% in order to meet the expenses of operation. No doubt this action was necessitated, and we are able to sympathize with the Director General, who must have been reluctant to take such a step. It tends to increase severely the burdens of the West on account of the long haul. At the same time it adds to the complexity of those industrial operations in the East that depend upon Western copper, lead, chrome, and other raw materials. It also will make the cost of meats and sugar distinctly higher. In fact, it is part of an endless chain of growing costs that is magnified the longer it is continued. We venture to point out that it is largely the result of discriminative price-fixing. The market quotations represent normally a balance between supply and demand. In times so extraordinary as these it is evident that the law will work to the injury of the people and the Government unless some restraint be exerted. This was recognized, and the prices of certain articles were officially regulated. The inevitable effect was to disturb the course of business and to impose greater hardships upon the restricted industries. It is true, as President Wilson said in his address to Congress the other day, that the profiteers can be reached by taxing their profits, but that does not save the public from being taxed first by the profiteers. The evil can also be corrected by introducing one rule for all and fixing the prices of all commodities. We are unable to see any other way by which the burdens of the people can be equalized. By cutting down exorbitant profits the Government can also reduce its own expenditures, which grow *pari passu* with the increase in market prices.

CANTIGNY is the first name to be associated with a notable exploit on the part of our soldiers in France. It is true that sundry raids and patrol affairs had been featured earlier by the daily press, but these had been rendered almost ridiculous by exaggeration. Cantigny is altogether different. The storming of this position near the point of the salient made by the Enemy's thrust at Amiens was a brilliant affair, to which the seal of resolute courage has been set by holding the ground against a series of savage German onslaughts. It is not surprising that the Enemy's bulletins try to ignore this part of the fighting, for he is unwilling to let his people know that the Americans have 'made good,' and more. Cantigny is destined to be the first of many French names that will be forever entwined with the story of American military support to the great cause for which the Allies are fighting against heavy odds in these critical days. The Berlin 'Tageblatt' may label the American troops "second-rate," but the jibe will prove as futile as that under which the "contemptible little army" of our Ally fought its way to undying fame.

PRICES for copper remain fixed at the old figures, 23.5 cents per pound for carload lots and 24.675 cents for smaller quantities. This will apply until August 15, when a new hearing is due the copper producers. Their recent experience affords no assurance that they will get it, since the War Industries Board is reported to have decided upon the price that is to rule for 75 days after June 1 before the conference with the producers was held. The plea of the small miner, to which we referred on May 25, has elicited the statement that consideration may be given to the problem of adjusting prices in harmony with the cost of production. This would afford relief, and probably would be accepted by the copper miners as a working basis. Nevertheless, it is necessary to progress cautiously in making such

regulations. We believe that jurists will agree with us in the opinion that a discrimination of this nature would be unconstitutional, unless it be conceded that in time of war all things are constitutional if done by a Government bureau. In the next place, a better price for copper from high-cost mines will set the labor unions busy equalizing the schedules, thus augmenting the difficulties as a snowball grows bigger the farther it is rolled.

OUR first lesson in the meaning of practical collectivism has been driven home by Secretary McAdoo. Shop-men on two important railroad systems, temporarily forgot the name of the concern for which they were working and struck. The Director General has written a kindly letter, and it is one that cannot be misunderstood. He reminds the workmen that a great army of their fellow citizens is confronting the foe in Europe and is dependent, in the face of grave peril, upon the earnest co-operation of all Americans in supporting their heroic efforts by sending forward an unbroken stream of supplies and ammunition. No strikes may be permitted at such a time. The sacrifice of the brave men suffering in the trenches and fighting day and night to protect their country, while only a pittance is paid to them as a token of the nation's gratitude, puts to shame the petty worries of men who live at home, who eat their meals in safety, and work under healthful conditions eight hours per diem. Incidentally, the labor unions have been asking to be freed from capitalism, and now the opposite system is being tried on a huge scale through Government control of the railroads. The first discovery made is that other forms of protest than the strike must be adopted when the complaint is against the people instead of a private corporation.

ZINC producers have suffered keen disappointment. Few of the metals felt so promptly the early demand arising from military needs; the prices swept from 10% below normal to 290% above, in the interval from July 1914 to June 1915, and they remained at a high level almost to the moment of our entering the War. The industry expanded proportionally, and mines were developed to an unwonted extent. The price, however, declined severely in the autumn of 1916, but a renewed demand was anticipated when war was declared by the United States. This failed to appear. No intimation of the probable requirements of the Government could be obtained, but many mines continued to operate at a loss in the hope of relief. When at last the Government took action the prices were fixed for the higher grades only, thus justifying the foresight of producers who had persisted in preparing to make electrolytic zinc. Recently a moderate demand for grade C has developed, but the outlook for heavy consumption of spelter by the Government is not encouraging. Consequently interest is being taken in developing new uses for the metal. The field for sheet-zinc to replace corrugated iron is attractive. At some mills preparations have been made to produce this material on a greatly enlarged scale. From Joplin comes word of a concerted effort by a group of zinc producers to stimulate invention by offering special rewards for the disclosure of new applications. Three prizes of $10,000 each are proposed for the first three practicable discoveries reported to the committee. Following these will be other prizes graduated from $5000 for a new use that will consume 50,000 tons of zinc per year down to $2000 for a new application involving a demand for 20,000 tons. The originator of the contest is Mr. F. C. Shoemaker, president of the United Producers Smelting Company, at Henryetta, Oklahoma.

REPRESENTATIVE KITCHIN has failed to display the shame that we believed he would feel when it was explained to him how his zone-postal law would help the cause of Kaiser Wilhelm. On the contrary, dispatches from Washington affirm that he charges a group of newspaper publishers, whose names apparently he hesitates to mention, with conspiring to influence congressmen to hold up the revenue bill until this law is repealed. Since Mr. Kitchin imputes motives we would like to ask him what has inspired his hostility to the free circulation of the organs of information in this country? Why was he afraid to introduce the postal-zone bill frankly and in the regular way, and let the light of publicity beat upon it? Why did he slip it through as a rider on a revenue bill at the last moment, and make its acceptance the price of his adherence to that vitally needed measure? How will the limitation of the sphere of influence of our great newspapers and magazines improve the intelligence of the people or draw them closer together in understanding sympathy? How will an increase in sectional feeling help to solidify the United States of America? Is it not true that intellectual intercourse and exchange of fact and opinions is essential for welding the populations of different sections into one people? Is not the accentuation of local ideas, unmodified by the views of other districts, equivalent to putting a premium upon sectional selfishness and jealousy? Is it not fair to ask Mr. Kitchin why he insists on a measure whose inevitable tendency will be to destroy the solidarity of his country? Is it not true that Germany will delight in sowing the seeds of sectional differences, which ultimately lead to animosities? Why does Mr. Kitchin persist in advocating a scheme that will redound to the advantage of our Enemy? He attributes motives to others; it is proper to demand from him an accounting as to his own motives. What are they?

PHOSPHATE-ROCK production dropped to the low level of 1,308,481 tons in 1915, and remained nearly stationary for two years. It has, however, returned to normal, being 2,003,991 tons in 1917, and the improvement has been sustained during the early part of the present year. The mines of south Florida have shipped 30% more in the last three months than during the same period of 1917. We are pleased to record this as a cheering evidence of two things regarding which opinion had differed in the absence of exact data; these are that fertilizer must have been available in practically normal

quantity for this season's crops, and that the output of sulphuric acid must have been greater than generally expected. It is certain that the phosphate miners will not produce far ahead of available shipping facilities, and fertilizer manufacturers will not buy the crude rock unless they have at command the acid for converting it. The combined quantities of imported Spanish pyrite and the increased tonnage from domestic mines correspond to the high level of acid production. How much of this acid is released for fertilizers can be judged only by the shipments of the raw phosphate. This is favorable for the crops of the present year, but we must not forget that the importation of Spanish pyrite will be reduced to 10,000 tons monthly by September, leaving a deficit of about 62,000 tons per month to be made good by augmenting the production of this country. We thoroughly approve the insistence of Mr. Philip N. Moore in his testimony the other day before the Senate Committee on Mines and Mining that the sure way to protect the country in a sufficient output of pyrite for supplying its vital needs is to fix the price for a period long enough to warrant the necessary outlay in development and equipment of mines. From all sides, from the prospector, the capitalist, the engineer, comes one accordant voice on the need of price-fixing for the essential minerals specified in the War Minerals Bill. Let Congress heed the opinion of those that are best informed, and put the Bill through at this session with the price-fixing power retained. Without that it will be of secondary importance, and the Government will have to fall back on the provision that allows it to turn prospector and miner in the effort to supply the necessaries of war.

Carrying the Message to Russia

Ukrainia is not at peace under the 'benevolent' despotism of the German militarists. Whatever the nobles in southern Russia may think of the Teuton, who promises them salvage of their estates from the turbulent anarchist, the common people see in the invasion of the blonde savages of the north only robbery and destruction. They prefer to starve by their own acts than to die that German looters may live, so they destroy the grain they cannot hide for surreptitiously sustaining the families dependent upon them. Throughout Russia the light of disillusionment is breaking upon the peasants. They had always distrusted the socialistic agitators and had declined to make common cause with them. We have the written authority of the two ablest and best informed political reformers in all Russia for that, namely, Leo Tolstoi and Paul Miliukov. The peasant, however, knows land; he yearns for free land and more land; it was on this sentiment that Ivan the Terrible played when he undertook to crush the turbulent nobility and strengthen his hold upon an expanded Muscovy. It was in the face of this fear of the conniving few, who preached reform while aiming at personal aggrandizement, that the vigorous butcher Menin rallied the land-tillers to secure their holdings under an emperor picked from the ranks of the plain people, and had the first Romanoff elected in a popular assembly to rule with unlimited power. That was in the days when democracy as we understand it had not been tested, and the idea of the people was that an autocrat who owed his elevation to them was safer than wrangling congresses composed of men devising ways to rob the helpless peasant. Evidently Russia has not progressed far beyond the status of those earlier days. She has escaped from the autocrat into the arms of the idiocrat whose name is legion. How can the message of sympathy for the peasant, whom we would rescue from the Bolshevist, be delivered? He threw down his arms because the agents of Germany that had seized the tangled reins at Petrograd used their most efficacious weapon by spreading the rumor of lands that were being subdivided. To each soldier's heart came the impulse to rush and get his share. Thus was the work of Germany accomplished; she knew the spot on the Russian body-politic where the linden leaf had fallen. It is for us to find how to withstand successfully the murderous hosts of Hagen. We know that Hindenburg has appreciated, better than Ludendorff and the obstinate Crown Prince, the importance of the East. He is what is called an 'Easterner' in his attitude toward the strategy of the War; likewise there are 'Easterners' in England and France, who believe that as soon as the German offensive in the West has become a demonstrated failure, the influence of Hindenburg will be seen again in a stronger thrust by military, political, and commercial penetration into Russia and southward. Meanwhile the British forces in Mesopotamia are being strengthened by nearly half a million men from India, and as these approach the North and break into the Caucasus the message of deliverance will be borne to the confused and suffering peasant of Russia. As soon as he sees the hand of protecting government again in the place of the robber and murderer he will recognize and respond to the message of true democracy.

Another Mexican Taunt

Washington newspaper correspondents represent the Administration as being startled by the action of Carranza in severing diplomatic relations with the government of Cuba. This evidently is a mis-statement, for the Department of State possesses accurate information concerning the pro-German attitude of Mexico, and is aware of the activity of the Teutonic agents, which have brought stranger things to pass than this. The patience of the Administration is becoming sorely strained, as was shown by Secretary McAdoo's remarks at El Paso a few weeks ago. The friction with Cuba was a convenient excuse to flaunt before the Latin-American republics the peculiar views of the 'First Chief.' Despite the urging of his envoys to the Argentine, he sees that country, under the leadership of President Irigoyen, recognizing the material advantage of maintaining cordial diplomatic and commercial relations with the United States; he observes Peru following the example of Argentine in strengthen-

ing the ties of pan-American fraternity by establishing a $20,000,000 gold credit with our Federal Reserve Bank; he has been disappointed in the failure of the president of Costa Rica to display resentment because his government was not recognized by President Wilson, for that enterprising little republic has become another champion of civilization by declaring war on Germany and thus manfully falling into line alongside of Uncle Sam. Accordingly Carranza takes advantage of a technicality to protest against a custom-house examination to which one of his special agents was subjected on his way from the Argentine, and he chooses to do it in a spectacular manner. Minister Candido Aguilar, speaking for Mexico, utilizes the incident to remind all Latin America that Cuba is a protectorate, and he hints darkly at the time when he may restore diplomatic relations between Cuba and Mexico on terms of "equality." In other words, the German is thus subtly indicated as a deliverer of oppressed nations, and our benevolent sponsorship for an autonomous Cuba, kept free from the fear of invasion, domestic strife, and ruin, is given the color of imperialism. The announcement in the dispatches that Spain has been the tool of Germany in stirring Mexico to this action is not credible. Everyone knows that Spain, as the mother country, is earnestly seeking to draw closer the bonds of sympathy between herself and her former colonies. To this no possible objection can be offered, and a precedent for it is found in the rapprochement of the English-speaking countries. We do not have to go far afield to discover the influences at work in Mexico. Practically all foreign houses have been driven out of business in the Mexican republic, with the exception of those controlled by the Germans. This has left the field open to them, and out of the profits accruing from exploiting the country they have expanded their operations until they have grown dominant in all branches of industry. Their financial strength has increased their usefulness to the government in its antagonism to American and British interests. Official favor has gone so far as to exempt firms that appear on our black-list from payment of the full amount of taxes due. These discredited firms continue to conduct business with the United States through other concerns, which so far have escaped the ban. Our tolerance has been great, but we cannot long permit the Enemy to use a neighbor as a base for his machinations against us. No quarrel exists between Mexico and the United States. We have done all that we could to re-establish a safe, dependable, democratic government south of the Rio Grande, and we would have succeeded but for the active propaganda of the Germans. A nation may repudiate our friendship if it so desires, but we are now at war, and we cannot suffer anyone to perpetrate acts inimical to our cause. The war we are waging is for the welfare of all mankind, for the weak as well as the strong, for Mexico as well as the United States. One of its results will be to preserve Mexico from absorption by Germany, and to ensure her freedom and autonomy. Every thoughtful Mexican must realize that fact, and must deplore the attitude of individuals that would keep us from establishing friendly relations.

A Professional Blunder

We hope every mining engineer that sees these opening lines will take the trouble to read this editorial to the end because it deals with a matter of vital importance to the profession. The statement of the case cannot be made brief because it covers a wide range in time and thought. It appears to us that an irretrievable mistake has been made, not by one engineer nor even by several, but by such part of the mining profession as has been connected with the big operations at Johannesburg. That mistake was the persistent ignoring of the inevitable impoverishment of the ore in depth. The economic collapse of several of the big consolidations of mining property on the Rand affords a reason for drawing attention to the blunder at this time. The pitiful plight of the East Rand Proprietary as a supposed 'investment' is indicated by the fact that the shares are selling now for 5 shillings as against 115s. in 1911. The American reader must excuse the use of British units of value, as they are always employed by those—European or American—interested in South African mines. As the East Rand Proprietary company has an issued capital of 2,445,897 shares of £1 each, the drop of 110s. per share represents a market-loss of £13,452,423, equivalent to $65,244,251. In 1909 the yield of the East Rand Proprietary was 29.2s. per ton, on 1,830,280 tons, at a cost of 15.5s. per ton, leaving a profit of 13.7s. per ton. For the year 1916 the yield averaged 24s. on 1,939,200 tons, the cost was 19s., and the profit 5s. per ton. It must be understood, however, that the so-called profit is one of the fictions of Rand financial custom, the real profit for 1916 being £182,963, which is the difference between the balance brought forward from 1915 and the cash available for dividends at the end of 1916. This is equivalent to slightly less than 2s. per ton. The phantom profits of the South African mines have long been an absurdity, if not a scandal, the incorrectness of them being due to the fact that they represent an 'operating' profit, from which taxes, London expenses, interest on debentures, and other expenditures have to be deducted. The quarterly report for September 1917 contained "the melancholy information that development is to be curtailed and confined entirely to the more favorable areas," so says the 'Mining Magazine.' In plain English, the mine is sick unto death. In 1910 the East Rand Proprietary was estimated officially to have a life of 30 years. Another big consolidation, acclaimed a few years ago as a gilt-edged investment but now depreciated to the status of an insecure speculation, is the Crown Mines, the shares of which have fallen to 40s. from 190s. in 1910, the difference of 150s. on 1,880,212 shares representing a market-loss of £17,862,-014, or $86,630,767. The report for 1916 shows a yield of 25s. on 2,266,000 tons, a cost of 18s., and a profit of 7s. per ton, as compared with a yield of 35s. on 1,618,500 tons, a cost of 19.33, and a profit of 15.66s. per ton in 1911. In this case also the supposititious profit of 7s. must be reduced to 4.23s. per ton. The camoufleurant

cost-statements of these South African companies are so aberrant that the dividends distributed by the entire region usually represent only 65 to 70% of the nominal profit recorded in the statistics of the Chamber of Mines. In 1910 the Crown Mines was supposed to have a life of 50 years. Besides the East Rand Proprietary and the Crown Mines, we may mention the Rand Mines as another consolidation of the supposed 'consols' type. This last is a holding company, owning large blocks of shares in a number of representative mines, so that the quotation of Rand Mines served as a barometer of Rand prosperity. In 1911 this stock was quoted at 175s. per share, now it stands at 60s., the drop of 115s. on 1,866,664 shares representing a market loss of £10,733,318, or $52,056,592. Thus these three consolidations, in less than seven years, have lost £42,047,755, or $203,931,610, in market-value. A number of other mining companies, appraised as safe investments, have suffered like depreciation. The loss to the public, in England, France, and Germany, has been colossal. But the less informed reader will say that this is the fate of mining enterprises; they do not last forever; a mine is essentially a wasting asset; it has its periods of development, production, and exhaustion. That is true, but it was claimed insistently by the mining engineers on the Rand—American and English—that the seams of gold-bearing conglomerate constituting the ore deposits of the Rand were unlike the ordinary type of vein, they were like beds of coal, they maintained their gold content as long as they persisted, and of such structural persistence there was absolute geologic proof. The mining engineers of the Rand were wrong, and most of them knew it, but they allowed the financiers and promoters—the 'big houses' as they were called—to use a fallacious argument for the furtherance of schemes the ultimate purpose of which was to transfer the money of the public into the pockets of a few financiers and promoters.

Let us take the East Rand Proprietary as an example. In 1907 Mr. Frederick Hellmann, then general manager for this company, testified before the Mining Industry Commission that a decrease in the grade of the ore was "most marked" in "all mines" with which he was acquainted on the Rand. He added that impoverishment was especially noteworthy in the Driefontein, one of the East Rand Proprietary group. This testimony was not published in such a way as to be read by the public, although known to the leaders of the industry at Johannesburg. Nevertheless, in March 1910, at a general meeting of the East Rand Proprietary company, Sir George Farrar and Sir Lionel Phillips, two successful promoters that had won knighthoods in the usual way, testified as directors to the shareholders that the Angelo Deep, another mine of the group, had "added to the evidence that the Witwatersrand series was not decreasing in value" in depth, and that "if they excluded the surface area down to 200 or 300 feet, there seemed to be no evidence whatever that the gold contents at the deepest levels were not fully as high as they were at the surface, or within 300 feet of the actual surface." Every well-informed mining engineer at Johannesburg and in London must have known this assertion to be false, but it passed unchallenged. We can go farther back. As early as 1903 Mr. Hennen Jennings, consulting engineer to the chief mining house, the firm of Wernher, Beit & Co., who controlled the Rand Mines company and many others, advised his clients that the evidence warranted increasing caution in commitments for deep development. His view of the matter was deemed so serious as to cause his firm to engage Mr. Ross E. Browne to come from California to South Africa, nominally to suggest new methods of mining, but actually to investigate the question of impoverishment in depth. His opinion, we understand, corroborated the cautious discernment of Mr. Jennings. Again the public and the shareholders were kept in the dark. In May 1903—15 years ago—the present writer, then editor of the 'Engineering and Mining Journal,' ridiculed the projects for tapping the Main Reef series at a vertical depth of 8000 feet, equivalent to 18,000 feet on the dip, and protested against the confident anticipation, in disregard of world-wide experience, that the 'banket' would continue highly profitable to an indefinite depth. That editorial was entitled 'Even Methuselah Died'; it suggested forcibly the mortality of mines as of men. It is evident now that the years of the Central Rand are numbered, for the latest projects for expansive development are being concentrated on the Far East Rand, where the Modderfonteins, the Brakpan, Springs, and other young mines give promise of generous productiveness. It is noteworthy that in this part of the Witwatersrand the dip of the Main Reef Series is so flat that a point 14,000 feet on the dip is only 3000 feet vertically below the surface. Similarly, the two rich mines at Grass Valley, California, have been developed to 6300 feet on the dip, but the workings are only 2500 feet vertically. The suggestion is that the persistence of ore is related to depth below the surface, not to distance along the dip.

The rise in share-values was allowed to proceed, the absolute safety of the gold-mining 'investments' of the Rand was a theme of enthusiastic editorials in the subsidized financial press, and 'widows and orphans' were invited to place their savings in the big consolidations that were formed ostensibly to afford a wider foundation of industrial security, but really to enable the 'big houses' to disguise sundry failures and to merge numerous poor areas owned by them with the richer parts of the ore-bearing ground. In June 1911 the 'Times' said: "The question of the lodes giving out, which is the bogey of most mining concerns, does not exist for the Witwatersrand, for, though the ore of the reef varies in value, there is no doubt that it exists in payable grades and in large quantities down to any depth at which it may be practicable to mine it." This statement was promptly contradicted by the present writer as editor of the 'Mining Magazine'; it is a specimen of the piffle that the non-technical press has published in complacent subservience to the financiers. In the course of time the mining

engineers of the Rand had bemused themselves with the idea of indefinite richness, or 'payability'—to quote the local terminology—until some of them even believed it. In the late boom of the consolidation era, about 1910, they even talked themselves into the belief that as the mines became deeper they could be operated more cheaply, so that it became not uncommon for the statement of ore-reserves to include millions of tons of 'unpayable ore' assaying two or three pennyweights, at a time when even the pseudo-cost was twice as great. Thus the East Rand Proprietary in its report for 1909 itemized, among its resources, 2,593,643 (note the meticulous precision) tons of 'unpayable ore' assaying 2.4 dwt., equivalent to a mill-yield of less than 8 shillings per ton. To the shareholder this implied the expectation that some day, somehow, this rock would become an asset from which dividends might be squeezed. It was humbug, but the profession in London and Johannesburg winked at it. They were wilfully blind to two axioms of experience: the impoverishment of ore in depth and the concomitant increase of cost with depth once the economic scale of operations has been reached.

Not only did the engineers of the Rand shut their eyes to the testimony of experience the world over, but they even denied the truth when it was asserted. On May 31, 1911, Mr. C. O. Schmitt read a paper before the Institution of Mining and Metallurgy on 'Future Economies in Rand Reduction Plants,' in the course of which he predicted a diminishing profit in depth, much to the annoyance of the sensitive-plants that flourish in the hot air of the share-market. He was flatly contradicted by Mr. H. F. Marriott, the successor of Mr. Jennings as consulting engineer to the Wernher-Beit control. At this meeting of the Institution Mr. Marriott stated, concerning the grade of the ore: "There is no substantial evidence today, even for the most confirmed pessimist, to prove a general deterioration. My opinion in this respect is not merely advanced as a benevolent idea, but is based on the most complete evidence it is possible to secure, that of the assay-values of samples of actual reef-widths taken throughout all the mines and correlated." He was challenged by the present writer to bring forward his evidence, but declined to do so, until in December 1914, at a meeting of the Institution, during the discussion of the present writer's paper on the 'Persistence of Ore in Depth' he exhibited a stope-diagram "as material evidence," so he said, "against the views of those who claim that the Rand is one of the instances of decrease in value in depth." On that diagram the richness of the ore was indicated by tints, the dividing line between high-grade and low-grade being an assay-value the amount of which he would not specify. This evidence was misleading because the dividing line was far below even the average grade of the ore produced for many years by several outcrop mines of this group. That such information should be regarded as secret, that it should be considered the peculiar perquisite of the controlling house, not to be divulged to the shareholders at whose expense it was collected, is in itself significant. On another occasion (in November 1914) the present writer was privileged to see a longitudinal section showing the stopes, 2½ miles long, of the East Rand Proprietary. On this map the ground worked out was colored blue; the rich, the moderately profitable, and the unprofitable ground were indicated by variant tints. It was a graphic presentation of the life of the mine. Mr. Marriott pointed to it as proof of his denial of impoverishment in the deepest workings. The writer looked at it carefully and weighed the evidence, coming to the conclusion, which he stated frankly: (1) that, including the 300 feet of oxidized ground, he would rather have the gold in the first 1000 feet in depth than the gold in the next 2000 feet, and (2) he would rather have the gold in the first 3000 feet than that to be won from that point to the barysphere. The truth was told by evidence in the possession of the technical staff, but they had shut their eyes to it, so that they failed to see it. The present condition of the East Rand Proprietary renders further comment superfluous. Mr. Hellmann's frank testimony has been quoted. Mr. H. H. Webb also was one of the few to recognize the logic of events, even if his acknowledgment was belated. In the report of the Consolidated Gold Fields of South Africa, issued in 1913, Mr. Webb stated: "There can be no doubt that, from our experience and in our mines, the average value of the ore developed over large areas has been getting lower as great depth is attained." This official acknowledgment of a fact known many years earlier to any observant engineer on the Rand was received by the officials of the other financial houses as a misfortune to which their mines were superciliously superior. In the public discussion of this question technical opinion was muted, whereas the loud pedal was placed on financial optimism. The mining engineers of London and Johannesburg could offer no constructive suggestion to overcome the impoverishment of the ore in depth, so they fell over each other in advocating the idea of consolidation, which served to postpone the day of reckoning. That day has come, and it is with no sort of pleasure that we must record the fact that the profession has proved wanting in courage and sagacity. It has allowed reckless promoters and predatory financiers, now titled millionaires, to milk the public; it has been false to science and subservient to chicane. It was not necessary to be disloyal to one's particular employer or to depreciate the market-value of the particular mine with which one was connected professionally. A paper before a technical society, a letter in a responsible journal, a cautious speech at a company meeting, warning the public that as surely as all men are mortal so eventually all mines must peter out—some pronouncement of a general character—would have sufficed, if made by any two or three of the leading engineers of the Rand. That would have checked the foolish expectations of the ignorant and handicapped the clever deceptions of the too canny. Instead, the mining engineers of the Rand allowed the public to be victimized. It was not only wrong; it was stupid.

Even Methuselah Died

[An editorial by T. A. RICKARD that appeared in the Engineering & Mining Journal of May 2, 1903.]

We have published a series of contributions to the discussion of the problems arising from the proposed sinking of shafts to cut the Main Reef series on the Witwatersrand at depths of from 5000 to 8000 ft. While this discussion has covered the main questions connected with mining explorations to be carried out at levels deeper than any as yet attained by modern engineering, all those who have taken part in the debate have been strangely silent in regard to one feature, which, from the point of view of an onlooker at New York, seems vital, namely, will the ore at these great depths prove rich enough to warrant the tremendous expenditure entailed by the shafts and equipment thus contemplated?

In his excellent book on the 'Deep Levels,' Mr. G. A. Denny, who, by the way, also avoids the awkward question of values at great depths, gives data which warrant an estimate of a million dollars, as the cost of the sinking and equipment of a shaft to a depth of 5000 ft. It is safe to say that shafts approaching 8000 ft. in profundity will cost fully two million dollars. Even this amount, however, is not overwhelming, by any means—having regard to the scale of operations contemplated—provided that the ore continues as profitable as it has been from the surface to, say, 1500 ft. measured vertically.

Our readers are aware that the proprietary owning claims which cover the croppings of a reef is called an 'outcrop company.' As the South African laws do not recognize extra-lateral rights, and the reef dips southward, the outcrop company can only follow the ore to a certain line vertically underneath its southern boundary. Beyond that line the dip carries the ore into adjoining property—the first 'deep-level.' In turn, the latter's rights cease southward as the dip carries the reef into the next property, the 'second row' of deep-level mines. And so on. The outcrop mines were, of course, the first to start operations; since then work has been begun on the first row of deep-levels; in many instances the second row is now being exploited, while, finally, in two or three cases even the third row has been tapped, the distance from the outcrop, and the consequent depth of sinking, varying according to the location of the claims. To this it may be added that as the consolidation of claims makes blocks of ground of irregular shape, the distance from the outcrop of the successive deep-level shafts varies between wide limits.

Of the results to date it is only necessary to say that the outcrop companies and the first row of deep-levels have demonstrated the Main Reef series to be the most wonderfully uniform gold lode ever mined by man. But several of the deeper mines have proved disappointing to an extent sufficient to emphasize the fact that while the 'banket' may be as uniform as a coal-seam, even a coal-seam will eventually pass into shale of little value as fuel.

The producing deep-level mines tabulated by Mr. Denny have vertical shafts ranging from 615 to 1608 ft., the average being about 1100 ft. These are 'deep' only in technical phraseology, because they occupy territory on the underlie of the reefs, the upper parts of which are owned by 'outcrop' companies. Returns obtained up to date from actual milling operations are manifestly of little value in forecasting the results to be expected at depths of 5000 to 8000 ft. In the calculation of probabilities 1100 ft. is to 8000 ft. as the vision of the unaided eye is to a telescope. The fact is, the term 'deep-level mine,' which at Johannesburg is used in distinction to 'outcrop mine,' has a misleading sound, and does not at all necessarily imply deep mining in the ordinary sense. It is doubtful if this is appreciated sufficiently.

However, there is other evidence. Eleven bore-holes have been put down to depths of over 2000 ft. Two of these—the Turf Club holes—cut the Main Reef series at 4825 and 4845 ft., respectively, with results ranging from 6 to 10 dwt. per ton, and widths of 34 to 45 inches. The working cost at twelve of the so-called 'deep-levels' averages 6½ dwt. But this does not allow for losses in treatment. A yield of 6½ dwt. per ton is equivalent to gold contents of slightly over 8 dwt., which then is the amount to be deducted from the assay in order to arrive at the profits. Therefore, having regard to the much greater depth and consequent larger expenditure in equipment, an ore carrying between 6 and 10 dwt. at 5000 ft., does not represent much profit, if any. But it warrants a certain amount of exploration.

The data obtained from the two deepest holes have been quoted. The others have given varying results. At 3309 ft. the Cinderella bore cut, in February of the current year [1903], a body of banket having with partings, an aggregate thickness of 16½ ft. Only 4 ft. of this was of payable grade, and the 4 ft. averaged 9.16 dwt. Another bore-hole, also over 2000 ft. in depth, cut 36 in. of banket at 2960 ft. This averaged 8 dwt. A fifth gave 14 in. of 17-dwt. ore, which is equivalent to a stoping width of about 6 dwt. Three other holes gave very low assays, and the remaining three reaching below 2000 ft., penetrated into disturbed ground, failing to cut any reef. While those last mentioned did not give direct evidence of poverty, they indicated that the irregularities of structure encountered in the upper levels will recur in depth—where, however, they will become a much more serious factor.

Of course, drill-holes are proverbially dangerous. Indeed, one might almost say that drill-holes have a depressing habit of going through the poorest places in a

lode or vein. Nevertheless, in default of other evidence, their testimony must be heeded. In so far as they throw light on the future of deep mining on the Rand, they hold forth no brilliant promise: the ore cut by them, even in the six fortunate holes, averages, for a stoping width of 4 ft., about 8 dwt., which is equivalent to an extraction of 6½ dwt. per ton.

However, to us there seems to be a much stronger reason for scepticism concerning the uninterrupted persistence of pay-ore, ore capable of yielding a good margin of profit, to such tremendous depths as those contemplated in the discussion on winding plants [by H. C. Behr and others]. A vertical depth of 8000 ft. means a distance from the outcrop, as measured on the average dip (26°) of the reef, of over 18,000 feet.

All the experience of mining is dead against the supposition of a maintenance of values over any such extraordinary range of lode-surface. Mines get poor, sooner or later, just as surely as men grow old. Even Methuselah died. It is a fact that the most persistent metal-bearing veins in the world, namely, those of the Lake Superior copper region—built up of conglomerate also, like the Rand banket—have at last begun to show signs of a change in character and a concomitant impoverishment. These mines have attained a vertical depth of a little over 5000 ft., equivalent to 8000 ft. from surface as measured on the vein. Of other deep mines, on the Comstock, at Bendigo, etc., it is needless to speak. Let the unthinking repeat the old fable that mines become richer in depth, but knowledgeable engineers do not need to be lectured on that point. Is not this brutal fact being evaded by the professional men who are directing the work on the Rand?

This important subject is broached with no desire to underrate the resources of the great Main Reef series. We appreciate fully the fact that never has gold mining been placed on so sound a basis as at Johannesburg, and we recognize that only those who have had a wide experience can really understand the difference between the hazards of an ordinary mining venture and the safe investment furnished by the established producing mines of the outcrop and first row 'deeps' of the Rand. There never were mining enterprises which assured so certain a return of capital and interest. But has not the inference, as regards future operations at six or eight thousand feet, been over-drawn, and is it not time to face the facts, in particular, as presented on the Rand, and in general, as furnished by other regions, and recognize that the rim of the synclinal basin affords better prospective chances than the long shots at the great depths contemplated in the discussion to which we have made reference?

TIN recovered on the Dutch islands of Banka and Billiton is not all alluvial, as popularly supposed. Lodes are now being worked. One mine is 350 ft. deep, with 6000 ft. of openings. Cassiterite and wolfram—2½% Sn and 1% WO_3—are found disseminated in greisen (quartz and mica). Two mills treat 200 tons of ore daily.

The Lambert Conformal Conic Projection

The Department of Commerce announces the publication by the United States Coast and Geodetic Survey of Serial No. 77, Special Publication No. 47, 'A Manual on Lambert's Conformal Conic Projections, with Two Standard Parallels,' by C. H. Deetz. This is the projection of the official map of France and is used in the war zone for the new battle-maps, displacing the Bonne system of projection heretofore employed by that country. The manual is issued in response to calls for information on the subject from several departments of the Government, as well as from outside sources. It comprises about 61 pages, illustrated by 14 figures and 7 descriptive plates. Besides a description of the projection, the mathematical development of its formulas, and the French system of kilometric squares in topographic mapping, there is included a comparison of the Lambert with the Boone and with polyconic systems of projection. Copies of the publication may be obtained at 75c. each from the Superintendent of Documents, Government Printing Office, Washington, D. C.

The Lambert projection offers advantages in the mapping of countries of predominating east-and-west dimensions. Its meridians being straight lines, and its parallels arcs of concentric circles, the projection is well adapted to indefinite east-and-west extension, a property belonging to this general class of single-cone projections, but not found in the polyconic where adjacent sheets have a 'rolling fit' because the meridians are curved in opposite directions. For a map of the United States, the maximum error in scale is reduced from 6½% in the polyconic to 1⅛% in the Lambert projection. The merits and defects of these two systems of projection are in opposite directions. A study of the shapes and extent of any areas to be mapped, therefore, is the deciding factor in the choice of a projection to meet the requirements that a map is to fulfill.

ALUMINUM alloys have been known to enter largely into the construction of zeppelins. Recently the 'Iron Age' obtained a piece of the metal from one of these German airships and had it analyzed. The composition proved to be:

	%
Aluminum	91.92
Copper	4.13
Iron	3.27
Silicon	0.65

The alloy had been rolled, and showed a tensile strength of over 40,000 lb. per square inch. It is assumed that the copper was introduced into the mixture in the form of silicon-copper.

TIN OUTPUT of Malaysia in 1917 amounted to 19,752 tons of metal, a decrease of 1974 tons compared with 1916.

Mining in the Lower Copper River Basin

By F. H. MOFFIT

*The Kennecott-Bonanza mine shipped its first ore early in 1911. Since then the Jumbo mine has been opened, and exploratory work has been started on the Erie claim. These properties all lie within three miles of one another, along the contact of the Nikolai greenstone with the Chitistone limestone on the east side of Kennicott glacier. They belong to the Kennecott Copper Corporation.

During the five years since 1911 a large quantity of high-grade copper ore has been shipped to the smelter from the Bonanza and Jumbo mines, and the mines themselves have been opened so as to expose the copper deposits and give a much more accurate idea of their extent and character than could be gained at the time when they were examined by S. R. Capps and the writer.[1] For this reason it seems desirable to describe these deposits more fully than the other deposits in the district, especially as such a description may be helpful to anyone who may be studying other copper deposits in the limestone. The writer acknowledges his indebtedness to those in charge of the mines for placing at his disposal every means for studying the copper deposits and in particular to H. D. Smith, E. T. Stannard, and A. M. Bateman for a great deal of information which a geologist who has not been closely associated with the work of exploration cannot get readily, if at all.

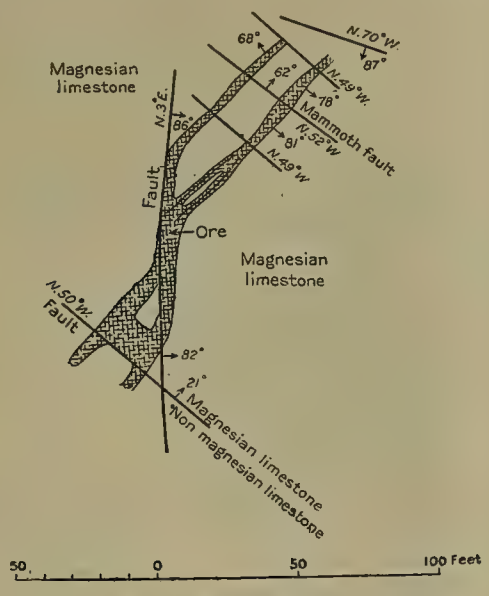


FIG. 1. FAULTING IN THE BONANZA MINE

THE BONANZA MINE is in the mountains between Kennicott glacier and McCarthy creek, at an elevation of 6000 ft. The Jumbo mine is nearly a mile north-west of the Bonanza and a few hundred feet lower. The main tunnel of the Erie is 1¾ miles still farther north-west, at an elevation of 4325 ft. and within half a mile of the Kennicott glacier.

The copper deposits of the Bonanza, the Jumbo, and the Erie resemble one another in the character of the ores and in the fact that they occur in the limestone only a short distance above the greenstone. It is therefore probable that they were formed at the same time and under the same conditions.

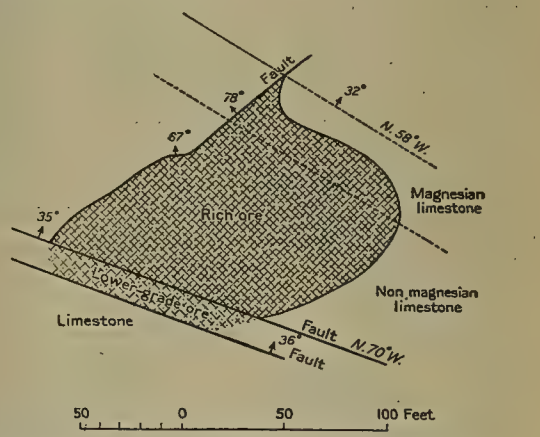


FIG. 2. HORIZONTAL SECTION OF JUMBO OREBODY ON 500-FT. LEVEL

The Bonanza mine is on a sharp ridge that separates the heads of Bonanza and National creeks, tributaries of Kennicott glacier. The head of National creek is a glacial cirque; that of Bonanza creek is also a cirque with a precipitous wall on the east, next to the mine. This cirque is still occupied by a small glacier. The ridge trends N. 30° E. From the mine the ridge rises steeply northward to the divide between Bonanza and National creeks and the basin of McCarthy creek, but extends southward without much variation in elevation for half a mile and then drops off steeply toward Kennicott glacier. A trail up National creek leads to the mine.

The geologic features are simple. On the south is the Nikolai greenstone (Triassic?), a succession of ancient lava-flows at least 5000 ft. thick. It is overlain by the massive Chitistone limestone (Upper Triassic), but is

*Abstracted from 'Mining in the Lower Copper River Basin.' By F. H. Moffit. Bull. 662-C. U. S. G. S.

[1]Moffit, F. H., and Capps, S. R., 'Geology and Mineral Resources of the Nizina District, Alaska,' U. S. Geol. Survey, Bull. 448, pp. 84-92, 1911.

separated from it by a thin bed of shale, which has a maximum thickness of only four feet and is easily overlooked except in favorable exposures, because the base of the limestone is commonly covered by debris from the cliffs above. A typical profile across the limestone-greenstone boundary shows steep cliffs of limestone above a moderate slope in the greenstone, although at many places the greenstone is hidden by loose material, or 'slide-rock,' as the prospectors usually call it.

The limestone between Kennicott glacier and McCarthy creek has a north-westerly strike and, in the vicinity of Bonanza mine, dips about 22° N.E. It is cut by numerous faults and fractures, some of which had a most important influence in directing the course of circulating waters and controlling the deposition of copper minerals. The faults comprise, among others, the two systems that had most to do with the formation of the deposits. One system is distinguished by fractures with steep dips and with approximately north-east strikes; the other by fractures with practically the same strike and dip as the limestone beds. Both fault-systems probably originated at about the same time. They are intersected by steeply dipping cross-faults, either of the same age as the major faults or possibly older, along which the copper-bearing solutions spread out for a short distance from the main fractures. They are also crossed by fractures that originated after the ore was deposited.

The ore-bearing faults and fissures of greatest importance among those just mentioned belong to a zone of fracture and faulting that extends N. 30° E. This zone is made up of steeply dipping faults and fractures that strike N. 30°–70° E. and that, together with the bedding-plane faults, were most effective in directing the flow of mineral-bearing waters.

The bedding plane or 'flat' faults indicate movement of one limestone bed on another or movement along a plane parallel or approximately parallel to the bedding. Such movement, however, was not restricted to planes of bedding, for in places the 'flat' faults are slightly wavy and cross limestone beds at a slight angle. Bedding-plane faults occur in the lower part of the Chitistone limestone at many places throughout Chitina valley, and at least four are recognized in the Bonanza mine. The contact of limestone and greenstone in particular was a place of movement, which was facilitated, no doubt, by the thin bed of shale at that place. Evidences of such movement are found in the shale at the Bonanza mine.

Two principal cross-faults are seen in the Bonanza mine, the Mammoth, which strikes N. 52° W. and dips 70° N., and the Azure, which strikes N. 62° W., dips high north, and is in reality a shear-zone about 100 ft. wide, made up of minor nearly parallel faults. The Mammoth fault produced a displacement of less than 20 ft. in the limestone and is older than the ore. The Azure fault is a normal fault that caused very little displacement. Movement has taken place along this fault since the ore was deposited, but the faulting may have begun earlier. Much of the limestone along the fault-zone is crushed. The direction of latest movement in the Azure fault is indicated on slickensided surfaces by striae that dip 70° west.

Although the Mammoth and Azure faults are the most conspicuous of the cross-faults in the Bonanza mine, many other cross-faults having the same general strike cut the principal ore-bearing fissures. Some of them are manifestly later than the ore, for they offset it. Some of them carry small quantities of ore, as may be seen on the 400, 500, and 600-ft. levels. It appears not improbable that cross-faults were produced when the principal shear-zone was formed and that movement took place along some of the faults of both sets after the ore was deposited.

It is difficult to make more than qualitative statements in regard to the displacements produced by faulting except as to a few of them. The vertical displacement along steeply dipping faults is slight. Some of the movement, particularly along faults that run north and south, was nearly horizontal, or parallel to the direction of the present dip. The displacement in this direction is small, but greater than that in the direction perpendicular to the bedding-planes. Displacement along the bedding-planes is difficult to measure because reference points are lacking, but in some places not far distant from Bonanza and Jumbo mines it is considerable, amounting to hundreds of feet.

Close examination of the rocks adjacent to the contact between the Chitistone limestone and the Nikolai greenstone at the Bonanza mine disclosed the following section:

Section at Bonanza Mine

	Feet
Limestone, magnesian, granular, ore-bearing.	
Fault; in places forms contact between magnesian and non-magnesian limestone.	
Limestone, dark gray, non-magnetic	50–60
Limestone, silicious, containing a little pyrite	20
Shale, red or green	4
Greenstone, amygdaloidal (Nikolai).	

The first large orebodies found were in the magnesian limestone, so that at one time it was supposed that this rock had controlled ore deposition, and exploratory work was conducted accordingly. As the work proceeded, however, this supposition had to be given up, for the ore was found in both the magnesian and the non-magnesian limestone. At some places a fault approximately parallel to the bedding-planes separates the magnesian and non-magnesian limestones, but at others the contact of the two is defined neither by a fault nor by a bedding-plane, but crosses the bedding irregularly.

The list of copper minerals in the ores of the Kennecott-Bonanza, formerly thought to include only chalcocite, covellite, and copper carbonates, has been extended as underground work proceeded and now includes chalcocite, covellite, azurite, malachite, enargite, bornite, chalcopyrite, bluestone or chalcanthite, and possibly other minerals. The ore is dominantly chalcocite. Covellite, like azurite and malachite, is common and, at least in some places, seems to be a product of the alteration of chalcocite. It forms veinlets that cut the chalcocite and it coats with tiny crystals the surfaces of open spaces in the chalcocite. Enargite is rare but is found in the

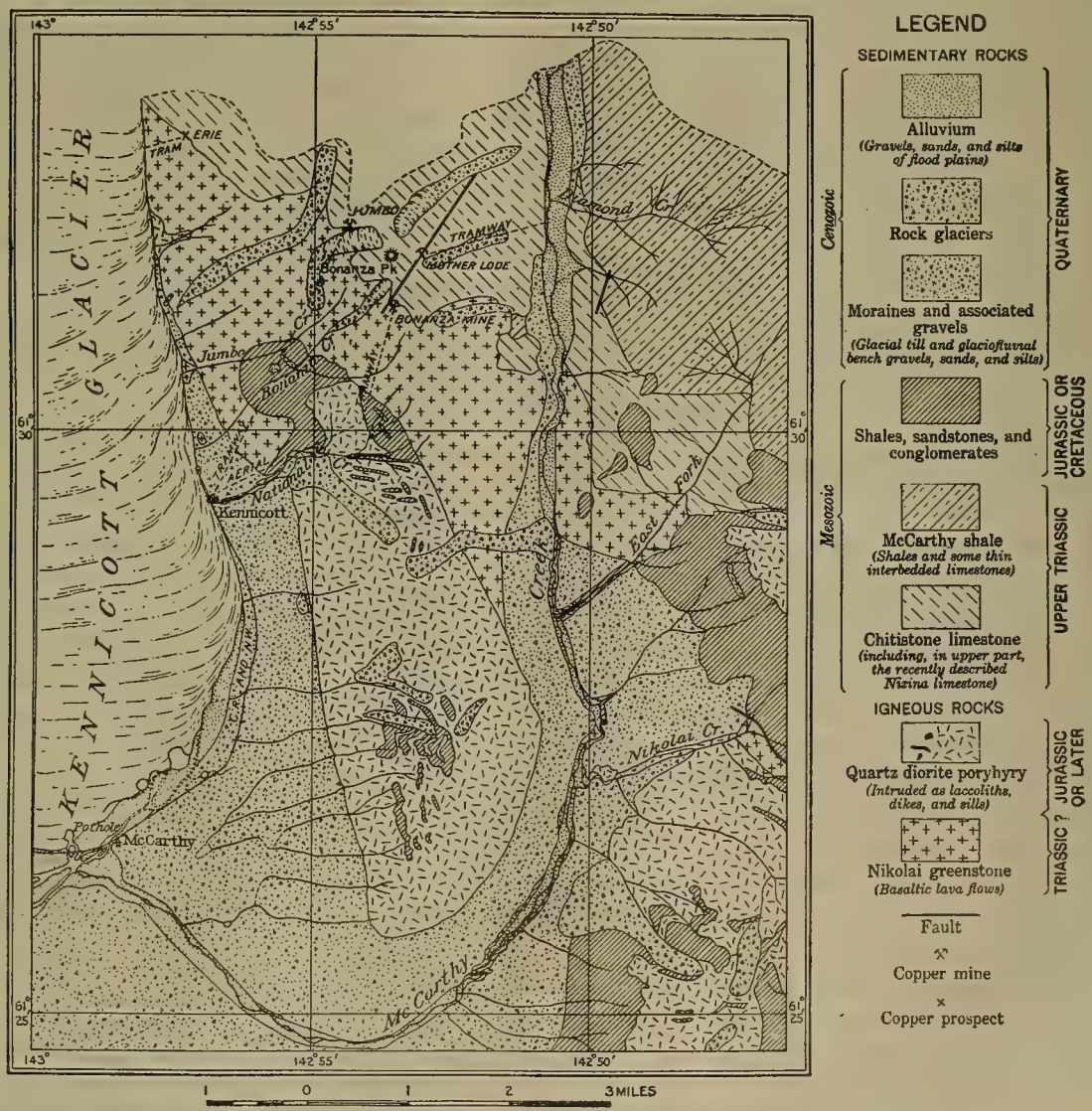
150-ft. and 300-ft. levels. Bornite is found throughout the mine and chalcopyrite in the lower levels, though it is uncommon.

The ore occurs as great tabular replacements of limestone along 'vertical' faults, as tabular replacements along 'flat' faults, as irregular masses, as networks in brecciated limestone veined with calcite, and as veins that have replaced limestone along bedding-planes and that are in places only a few inches apart.

The great orebodies belong primarily to the 'vertical' fault-system and have been found at the intersection of the 'vertical' with the 'flat' faults. They lie above the flat fault and terminate sharply against the underlying limestone, yet copper ore is found along vertical fissures below the flat faults at some places, as in the 'little bonanza' open-cut at the south end of the orebody. The little bonanza is a mass of chalcocite, covellite, copper carbonates, and chalcanthite in vertical fissures of the main fault-system, which lies on the west side of the ridge and extends down to the shale. It was not exposed to view until the talus material had been cleared away.

The largest orebodies so far uncovered were found at the south end of the mine. They followed fissures striking N. 50°–70° E. and were adjoined on the north by smaller bodies striking about N. 30° E. The formation of the larger deposits was much influenced by the Mammoth fault, for, although the limestone beds were not greatly displaced by the fault, the copper-bearing solutions spread out along it and produced local enlargements of the orebodies. South of the fault the ore reached a width of about 80 ft., but a short distance north of it the width was much reduced. The Mammoth fault appears only in the upper levels, for it crosses the south end of the orebody and reaches the north-eastward dipping

U. S. GEOLOGICAL SURVEY BULLETIN 662 PLATE XI



SKETCH MAP OF VICINITY OF McCARTHY AND KENNICOTT.

surface of the greenstone between the 200 and 300-ft. levels.

The 'vertical' bodies of the higher levels had a high westerly dip, which increased in steepness as the ore was followed in depth toward the north-east. Ore was mined in the main fissure-system to a width of 85 feet.

The ore is cut by faults that show little displacement, at least not much is shown by the steeply dipping faults. The Azure fault is over 800 ft. north-east of the Mammoth fault. It appears in the 300 to 600-ft. levels and meets the greenstone between the 600 and 700-ft. levels. Movement took place in it after the ore was formed. Three other principal vertical north-south faults offset the orebodies, as is evident at the surface and in the 100-ft. level of the mine. Such faulting as that indicated in Fig. 1, however, apparently took place before the ore was deposited and offset the two earlier faults, which the ore-bearing solutions followed later.

The north-south fault caused displacement chiefly in a horizontal direction. One of the striking features of the ore deposits is the sharpness with which they are limited by some of the fault-planes. In many places a thin gouge, scarcely thicker than a sheet of paper, has been sufficient to prevent the solutions from reaching the limestone on one side of the fracture while that on the other was being entirely replaced. The gouge along the fault-planes is locally highly colored with iron oxide.

The exposures at the surface of the Bonanza mine show no more oxidized ore than those in some of the lower levels. Oxidized ore continues to the lowest (700-ft.) level and is evidently most abundant where the ore was faulted and crushed and where water could therefore circulate freely. Oxidation is at some places confined to one side of a tight fault. Locally the chalcocite is brecciated and much oxidized, showing kernels of original chalcocite in oxidized ore. The Bonanza at present is a dry mine.

The workings have now reached the 700-ft. level. The adit is the 150-ft. level. From that level an incline runs nearly parallel to the contact of limestone and greenstone and descends to the 600-ft. level. From the incline, in turn, levels are driven off north-eastward into the orebody. A winze has been driven from the 600-ft. level to the 700-ft. level. The 300-ft. level connects by a short raise with the McCarthy creek side of the ridge. Much high-grade ore, including most of that exposed originally at the surface, has been mined above the adit-level, through which it has been drawn off. In this mine thorough exploration is necessary to trace the ore; all small veins and stringers must be closely followed, for many of them develop into valuable bodies of ore within short distances.

JUMBO MINE. The copper deposits of this mine resemble in most respects those of the Bonanza. The mine is in the Chitistone limestone, near the head of Jumbo creek, just above the contact of the Chitistone with the underlying greenstone. Jumbo creek originates in a small glacier on the west side of Bonanza Peak and flows south-westward to Kennicott glacier, which it joins 1¼ miles north of Kennicott. The glacier is confined on the north and east and for some distance on the south by precipitous cliffs of limestone. The Jumbo mine is in the north wall of this cirque, nearly half a mile from the head of the glacier. All the mine-buildings are set on the glacier.

The geology of the mine is practically the same as that of the Bonanza. A stratigraphic section shows greenstone at the base overlain by two feet of shale. Then come, in ascending order, about 20 ft. of silicious limestone containing a little pyrite, 50 to 60 ft. of dark-gray limestone, and finally granular magnesian limestone. In the adit or 180-ft. level of the mine the limestone beds strike N. 50° W. and dip 34° N. The dip is therefore a little greater than at the Bonanza and the strike is a little more westerly. A short distance east of the entrance of the 100-ft. level of the Jumbo a light-colored porphyritic dike two feet thick intrudes the limestone. It has not yet been encountered underground.

A fault-zone whose general course is a little south of north-east cuts the limestone but displaces the beds very slightly. It comprises fissures and minor faults that range in strike from N. 60° E. to east and a few that strike about N. 30° E. This fault-zone is made up of the principal ore-bearing fissures. Near the outcrop of the ore the dip of these fissures is 70°–80° W., but as the fissures are followed to the north-east the dips become steeper and in some of the faults are south-east.

The main fissure-zone is cut by cross-faults that trend north-northwest and by a few that trend north. At one locality the ore is displaced one foot by a fault that trends north and at another place two feet by a fault that trends north-northwest.

Of much more importance than these cross-faults are the bedding-plane or 'flat' faults. In the Jumbo mine, as in the Bonanza, the bed of shale between the limestone and the greenstone is evidently a plane of movement, for wherever the shale is exposed it is crushed to a thick gouge. The fault along the shale bed has apparently a much less significant relation to the copper deposits than the fault immediately below the rich orebodies. This fault is about 80 ft. above the greenstone and is in places made up of several closely spaced parallel faults. It does not strictly follow the bedding-planes but crosses the bedding at a slight angle, and on the 500-ft. level it strikes N. 70° W. and dips 35° N. It is cut by all the levels and marks the bases of the rich orebodies. Movement along this fault-plane after the ore was deposited is indicated on the 180-ft. level by a fault-breccia containing a little chalcocite. Although this post-mineral movement has taken place, the original displacement occurred before the ore was deposited.

The ore of Jumbo mine is prevailingly chalcocite, but includes a subordinate quantity of copper carbonates, as well as enargite, bornite, and chalcopyrite. In places covellite is associated with the chalcocite. According to H. D. Smith, in charge of the mining, if the proportion of chalcocite and carbonates that can be distinguished by the eye is estimated as 98%, then 1.9% will represent the

covellite and 0.1% the bornite and chalcopyrite. This estimate is, of course, only approximate, but it indicates the relative quantities of the copper minerals in the ore. The ore from the Jumbo mine shows more oxidation than that from the Bonanza. The carbonate ore consists generally of malachite and azurite, but that in certain stopes includes malachite alone. Silver occurs with the copper at the Jumbo mine as well as at the Bonanza. The proportion is slightly variable and ranges from 14 to 16 ounces per ton of high-grade ore. The silver content of chalcocite near fissures is less than that found at a distance from them, a fact demonstrated by careful assaying. The width of the ore-bearing ground worked is not less than 240 ft., yet the limits of the ore have not yet been reached.

In form the orebodies are like those of the Bonanza. The large tabular masses of chalcocite replace limestone along the north-easterly striking faults, but all openings in the fractured limestone along the fault-zone were invaded by the ore-bearing solutions so that stockworks and irregular orebodies are common.

Ore was deposited in great quantities at the intersection of the 'vertical' and bedding-plane faults between the 400 and 600-ft. levels. The 'vertical' faults here strike N. 65° E. and dip steeply to the north-west. The bedding-plane fault strikes N. 72° W. and dips 34° N. The great orebody was on the south-east side of the main 'vertical' fault and lay for the most part, but not entirely, above the bedding-plane fault, between it and the magnesian limestone. It extended from a point a short distance above the 600-ft. level to a point 30 ft. above the 400-ft. level. In projection on a horizontal plane it had a length of 400 ft. At its lower end was an open cave in the limestone, partly below and partly above the fault. A horizontal section of the orebody at the 500-ft. level is shown in Fig. 2.

This great mass of ore was practically solid chalcocite, with which was mixed an almost insignificant quantity of included limestone, largely altered to residual clay. It yielded 50,000 tons of copper ore, much of which ran 76% copper. This massive body of chalcocite was at the 500-ft. level, bounded on its lower side by a bedding-fault, but below this fault there was ore of lower grade which was terminated, 6 to 8 ft. lower, by a second fault parallel to the first, beneath which no ore was seen except a few tons at one place.

A map of the 500-ft. level shows, in addition to the orebody just described, two principal tabular orebodies along parallel 'vertical' fractures extending north-eastward and other irregular orebodies. On the 700-ft. level also there were two main fissures at the north-east extension of the drifts. The sharp clean-cut boundaries between limestone and chalcocite and the total absence of gangue-minerals except calcite are striking features of the ore deposits both here and at the Bonanza.

The main adit of the Jumbo mine is the 180-ft. level. This level penetrates between 200 and 300 ft. of greenstone before entering the limestone. From this level an incline with a slope of 33° to 34° descends to the 700-ft. level, in which a shaft is being sunk. The incline was started with the expectation that it would penetrate barren ground away from the orebody, but it encountered much high-grade ore. Intermediate levels were driven to the north-east from the incline into the orebodies, just as they were at the Bonanza.

Federal Explosives Law

Under the new Federal Explosives Act approved by the President on October 6, 1917, and effective November 15, 1917, every person was required to have a license for the purchase, possession, sale, or use of explosives, or engredients of explosives. Explosives are dynamites, blasting and shot-gun powders, caps, and many other commodities listed in the Act, as well as the component parts of these materials, which under the Act are classed as ingredients. The Bureau of Mines of the Interior Department is charged with the enforcement of this law. The Director of the Bureau of Mines has appointed Licensing Agents for the issuing of licenses in every hamlet, village, town, and city in the United States. In California we have over 700 licensors equipped and commissioned to issue licenses. The County Clerk of every county in California is appointed a licensor. In almost every instance Justices of the Peace are appointed licensors, as well as Notaries Public. To obtain a license an applicant must appear in person before the licensor; must state under oath his place of birth, if a naturalized citizen, must give the date and place of naturalization. Licenses will not be issued to enemy-aliens, or to subjects of a country allied with an enemy of the United States. Subjects of neutral countries are entitled to licenses if they are known to be loyal and responsible. Licensors are instructed to refuse to issue a license to any person not known to be loyal and responsible unless recommended by reputable citizens of the community. A person who has been refused a license by a licensor may appeal to the National Council of Defense at Washington. If the National Council of Defense grants the appeal it will make an order upon the Director of the Bureau of Mines to issue the license. The purpose of the Act is to prevent disloyal persons from procuring explosives, and to keep explosives out of the hands of persons who will not guard them carefully enough to prevent them from being stolen or used by disloyal persons.

PENALTY: Sec. 19. That any person violating any of the provisions of this Act, or any rules or regulations made thereunder, shall be guilty of a misdemeanor and shall be punished by a fine of not more than $5000 or by imprisonment not more than one year or by both such fine and imprisonment.

Location of licensors, or other information regarding the Federal Explosives Act can be obtained by communicating with John M. Griffin, U. S. Explosives Inspector for California, Madera, California.

FUEL-OIL CONSUMED by United States railroads during 1917 amounted to 45,707,082 bbl., an increase of 8.5%. Oil-burning locomotives operated in 21 States.

Nitrate-Plants

By DAVID HOLT

*The United States government has made provision at Muscle Shoals for the production of 180,000 tons per annum of nitric acid by the cyanimid process. Though the completion of dam No. 2 will not give to Decatur, Huntsville, Chattanooga, and other up-river points the year-round navigation desired, recent changes in plans will provide a surplus of electric energy to be used by the Government for other enterprises, or for privately-owned industries. While rejoicing at the establishment of a cyanimid plant at Muscle Shoals that will cost the Government more than $30,000,000, and the construction of dam No. 2 on a scale that will involve the expenditure of $20,000,000, the advocates of Tennessee river improvement do not feel that their work is completed, but only that it is well begun. The dam as it appears when completed, together with the power-plants thereon, will be a monster monolith of concrete. There will be no necessity for later changes to increase the utilization of power. Practically the entire potential horse-power of the Tennessee river at that point will be brought into service.

The air-nitrates plant at Muscle Shoals, the larger of the two now under construction, will use the cyanimid process, and the smaller, situated between the cities of Sheffield and Tuscumbia, will use some modification of the Haber process, which has been successfully operated for several years in Germany. For the Haber-process plant, known to the Government as Plant No. 1, the requirements of electric energy and crude material are proportionately less than those of the cyanamid plant. At first Plant No. 1 was referred to as the 'experimental' plant, but now objection is made to the use of this designation. The men who are responsible for its construction say there is nothing experimental about it; that both the process and its application have been proved and demonstrated. They call it the 'synthetic ammonia' plant.

Still, the cyanamid process is the one in use at Niagara Falls, where, on the Canadian side, nitrate of ammonia, nitric acid, anhydrous ammonia, cyanides and case-hardening compounds, together with many other products, are now being manufactured in commercial quantities. Cheap electric power, abundant limestone and coke are essentials for the manufacture of cyanimid. An authorized statement gives the information that, by the cyanamid process, the air is first liquefied by intense cooling under high pressure, pure nitrogen is boiled off, which is absorbed in a white heat in a powdered mass of fused lime and coke. The pure nitrogen absorbed by the powdered calcium in a special oven forms cyanimid. It requires about one horse-power of continuous electric energy to produce two tons of cyanamid per year. By June 1 the synthetic plant, costing $5,000,000, and occupying a 1700-acre site, is expected to be ready for manufacturing nitrates for explosives under the modified Haber process for producing ammonia, nitric acid, and ammonium nitrate. No. 1 plant is situated at West Sheffield, on the south side of the Tennessee river, and is being built under Government contracts with the J. G. White Engineering Corporation of New York. The machinery is being installed by the General Chemical Co. of New York, which controls the Haber process and has donated it to the Government for military purposes. It will have a daily capacity of 30 tons of ammonium nitrate and 4 tons of nitric acid. No. 2 plant, for which $30,000,000 is available, is being built at the new town of Muscle Shoals on the Government reservation adjoining Sheffield. Until the completion of the Muscle Shoals power development by the Government, electricity for the nitrate plants will be supplied from two steam-driven electric generating stations developing 60,000 hp., being built for the Government by the J. G. White Engineering Corporation, and from the big steam-driven electric plant which the Alabama Power Co. of Birmingham is building on the Warrior river at the mouth of a coal mine.

*Abstract: 'Manufacturers Record,' April 11, 1918.

Consumption of Tin in the United States

According to a statement issued by the War Industries Board from returns obtained through the sub-committee on pig tin, the consumption for different purposes in this country during the calendar year 1917 was as follows, in long tons: tin and terne plate, 27,600 tons; solder, 17,000; babbitt and other bearing metals, 10,800; brass and bronze, 4800; foil, 4000; collapsible tubes, 2100; white metal, 1764; and miscellaneous, 8193; making a total of 76,257 tons.

The miscellaneous item has been subdivided as follows:

	Long tons
Galvanizing	105
Tinning and re-tinning	1916
Partly for tinning and re-tinning and partly for other uses	595
Bells (reports of 3 manufacturers making bells only)	15
Pipes (tubes), for organs and soda, beer, etc., fountains	276
Partly for pipes and partly for other uses	620
Rubber	126
Type metal (reports of 2 manufacturers making type metal only)	35
Bullets	65
Plated ware, britannia ware, etc	1002
Chemicals (oxide, bichloride, crystals, and tetrachloride and crystals)	1718
Not specified	900

As the United States is almost wholly dependent upon foreign sources for tin, it is of interest to note that importations of tin and tin ore during the first quarter of 1918, stated in terms of metal, have been at the rate of 5873 long tons per month or 70,476 tons per annum. To get an accurate estimate of our total supplies, however, the amount of tin recovered by detinning plants and in other ways should be added to these imports, as well as the almost negligible amount of tin produced in this country. Our exports of domestic and foreign tin, although small, should also be taken into consideration.

The Mining Industry: The Keystone of Modern Civilization

By R. H. STRETCH

It is perfectly feasible to demonstrate the truth of the above caption. In sculpture, poetry, oratory, philosophy, and kindred lines of mental development, it is generally admitted that we are no more than the equals of the Greeks and Romans in the palmy days of their art and literature. We differ from the men of those far-off days only in our mastery of the mineral resources of the earth and in our ability to make them subservient to the cause of science and, through science, to the more perfect and luxurious housing, clothing, and feeding of the human race. The advance has been along purely materialistic lines.

While mining began with a knowledge of the uses of copper, tin, and lead, many ores of which are easily reducible to the metallic form, the main impulse was imparted by the discovery of means to separate the more refractory iron from its matrix, and the manifold uses to which that metal could be put. The nations possessed of this art conquered the less fortunate races and changed the destiny of empires. It has widened the domains of poetry and music by mechanical improvements; by similar means it has made it possible to reproduce statuary in facsimile; it has enabled us to perfect instruments so as to supplement the knowledge of the Chaldean astronomers and unlock the secrets of the heavens; it has extended our knowledge of the earth, banishing the weird fancies and speculations of Aristotle and his co-workers in the infancy of science; it gave us the alchemists and their less empirical successors, who, while delving into the mysteries of nature by which they were surrounded, have made discoveries that have revolutionized our daily lives. Progress was slow, and it took centuries to batter down the stone walls that ignorance had erected around preconceived ideas and dogmas. Animal and human labor were the chief sources of power, and were handicapped by the difficulty of application where concentration on a large scale was a prerequisite to success. Being unable, in the early stages of discovery, extending over many centuries, to handle underground waters, explorations were necessarily confined to such mineral deposits as were found on the surface of the earth and could be drained of water by gravity only. No deep mining was possible. Sculpture might flourish and magnificient buildings might be erected out of brick and stone quarried from the mountain sides, but easily accessible mineral deposits may have been easily exhausted or have become valueless for want of fuel through deforestation. Such causes may have deteremined the fate of nations that lived and perished in the steppes of central Asia, leaving no record, even mythical, other than scanty ruins, now entombed in the drifting sand-dunes. Histories dwell upon the doings of kings and knights, but usually fail to tell the young student that carpets and table-forks were articles of luxury in the time of Queen Elizabeth of England, that is, about the middle of the 17th century, less than three hundred years ago. Looking back at the social amenities of that period, and comparing them with those we enjoy today, the latter seem to be veritable products of a wizard's wand.

The first vital episode in the history of mining was the discovery that coal was an available fuel. At this date it is such an essential element in the scheme of our existence, that it is difficult to realize that England only began to mine it commercially early in the 13th century, or about 700 years ago, under the name of sea-coal (to distinguish it from wood-charcoal), given to it because it reached London by water, land transportation in those days being impossible. Roads, as we know them, were non-existent.

The mysteries beneath the surface of the earth were not unlocked until Newcomen and Watt gave us the master-key when they produced a practical steam-engine about 1775, not more than 150 years ago. Newcomen depended upon the expansive power of steam for one stroke of the piston and atmospheric pressure for the other. Watt used steam for both strokes, keeping the cylinder hot, and this today is the basis of all engines using steam as motive power. Small as was the change, it has had an influence on civilization beyond conception. From that day the advance has been of ever-increasing rapidity. Each completed engine made it possible to forge and build engines of greater size and power, until we are now able to embody the strength of 50,000 horses in one unit and forge enormous ingots under 1000-ton hammers; and every part of these machines has been retrieved by the mining industry from the subterranean treasure-houses of the world. The stimulation of research into the hidden qualities of the metallic elements went hand in hand with this development and evolved the locomotive, the ocean steamer, the automobile, and the intricate machinery of a thousand industries, to be followed by the aeroplane, the telegraph, telephone, and wireless, and the other marvels that have followed in the wake of the harnessing of electricity to the daily routine of life. To visualize the marvelous transformation we must realize that the mastery of the metals has done more in a century and a half for the physical well-being of the human race than the entire 6000 years which preceded them. Coal



THE PERSEVERANCE (ALASKA GOLD) MINE AND THE ALASKA JUNEAU

and iron have been the moving factors in this process of civilization.

It is only necessary to look over the contents of a modern dwelling to realize the truth of the foregoing statements. There is not one item that is not made out of one or more of the major metals, or on which they have not been employed in their fashioning or transportation to their present place. The stone was wrought with iron tools; the brick was molded by machinery; the lumber was cut with steel saws and worked by chisel and plane; the gas and water were brought in iron pipes, the electricity by iron or copper wires; the curtains, carpets, clothes, and table linen were woven on metallic looms; the furniture, ornaments, and kitchen utensils have all felt the touch of steel; the entire structure of the house and its contents have been assembled from the four quarters of the globe by methods of transportation dependent on iron and coal for their existence.

The productive industries that have furnished the raw material out of which the house has been erected and its contents manufactured are in the order of their relative importance, fishing, lumbering, agriculture, and mining. Fishing was a purely local industry, until boxes and barrels were made; until metal retainers were introduced for the canned product, and cold storage solved the question of the distribution of the fresh article, and a vast transportation system permitted the use of the perishable food at long distance from the point of production.

In like manner lumbering became an industry with the introduction of metal wedges, axes, and saws, gradually expanding with the building of power-driven mills supplied by means of tramways and locomotives with their necessary metallic chains, ropes, and other incidentals; but the industry could never have attained its present importance without the existence of ramified transportation lines reaching every point on the continent and beyond the seas.

Similarly, agriculture could never have fed the teeming multitudes in the large cities had it not been for the introduction of metal plows, steam-plows, reapers, and threshers, vastly increasing the productive power of each human unit beyond the requirements of his own immediate family; but the surplus would have been a waste product had not a system of rail and water transportation made possible the distribution of this extra product to the millions of artisans engaged in converting the raw products of the forests, plains, and mountains into available form; or to the other millions engaged in distributing these finished products to the lumber-men and agriculturists, as well as to the workers in the mines who also are non-producers of food and clothing and only partly of building material.

A people dependent on the lumber interest alone can never become a world power, neither can a purely agricultural community reach the same elevation, even if possessed of rapid transportation. Being compelled to import their mineral supplies, they cannot successfully enter the manufacturing field in competition with other communities amply supplied with the minerals that dominate our existing social fabric.

The mining industry is the one that vitalizes all the others, that makes their expansion possible. It furnishes the fishing, lumber, and agricultural industries with the tools of their trades. It has made it possible to house and clothe and feed the dense centres of population; to conserve surplus perishable food against periods of



MINES. THE EBNER IS ON THE EXTREME RIGHT OF THE SAME RIDGE

small production; to spin the cotton, flax, wool, jute, and other textile materials in quantities absolutely impossible by hand-labor; it furnishes the light, heat, and motive power of the nations; it has brought to the worker luxuries unknown to his forefathers; its beneficent influence is felt by all every minute of the day; and, by increasing the facilities for travel, it is lengthening the available working hours of the human race, through the saving of time. Moreover, it has given the nations a better knowledge of each other, broadening our sympathies, breaking down racial barriers, and hastening the brotherhood of man. Science is dependent upon it for all its instruments of precision; the world is dependent upon it for the education of its swarming millions! The one blot on its escutcheon is that it also furnishes the terrific engines of war, which have kept pace with our peaceful advance by their increased variety and destructiveness. Every shell is one nail more in the nation by which it is fired, a discount on its future resources.

Its culminating effects are seen and felt in the increased size and speed of vessels engaged in the ocean traffic; and in the hundreds of thousands of miles of railway that have covered the world with an intricate network reaching even its remotest corners. It is this system that has built up the congested centres of population with their varied industries, and it is imperative that the system be kept in perfect working order, and expanded steadily to satisfy the demands of the ever-increasing number living under these conditions.

No city ever contains within its boundaries supplies of coal and food-stuffs for more than a brief period, and with its railroad arteries in possession of an enemy must soon succumb to famine or perish with cold. Natural causes, such as floods, snow, or excessive cold, may produce a blockade almost as effective, as shown by the unfortunate combination of all these adverse factors on the Atlantic coast of the United States last winter when, in spite of an abundance of the required articles, it was a physical impossibility at times to place them within reach of those who needed them so urgently.

The subject might be expanded indefinitely, but the thoughts suggested should suffice to convince the most skeptical, if followed to their ultimate conclusions. In every case it will lead to the truth of the caption at the head of these pages; that the mining industry is the keystone of modern civilization. It follows that a nation with abundant mineral resources can face the world, for all other nations not equally endowed will send it their choicest products in exchange therefor, but when, in addition to metallic wealth, it possesses boundless resources in the shape of forests, fertile plains, and prolific fisheries, it can command the world. Nations have cast covetous eyes upon and have fought for the mineral wealth of their more fortunate neighbors for centuries. Belgium and the Rhenish provinces have been such a battle-ground; hand out your gold was the everlasting cry of the Spanish conquistadores!

In view, therefore, of the absolute necessity of an abundant supply of coal, iron, oil, copper, tin, lead, and zinc, to say nothing of the minor metals, or of gold and silver, for the maintenance of the present physical conditions of life and their expansion in the future, it becomes interesting to sketch the origin of mineral deposits and the amount available for the generations that will follow us; for on these possibilities depends the chance of further industrial development, or of a gradual decay due to

the exhaustion of the raw materials on which it is based.

We can re-forest denuded acres and maintain the fertility of the soil by the conservation of fertilizing matter and periods of rest; we can re-stock depleted waters with fish raised artificially, but it is absolutely certain that human effort can never make an ore deposit. For these we must depend on the operation of natural forces, acting over periods of time inconceivably great. Such forces are the gradual disintegration of the rocky crust of the earth by rainfall, sunshine, frost, and wind; the solution of the liberated particles by underground waters and their transportation to a place of rest, often far-distant from the place of origin, such points being determined by chemical conditions or imperfectly understood forces. In general terms, all metallic orebodies have been formed by such a sequence of events. Petroleum and natural gas are, in part at least, the chemically re-arranged elements of animal and vegetal life that lived, died, and were buried on prehistoric shores millions of years ago; whereas coal, even of inferior quality, has a similar antiquity; and the deeper-seated superior varieties are many times more old.

It is plainly evident that men are mining and using all of these materials more rapidly than nature is collecting or depositing them in available form; and it is equally evident that in any one locality the daily extraction from known sources is depleting the visible supply of that region, and that avoidable waste is a national crime for which future generations will rightly hold us responsible. The time may come when a nation will have to place an embargo on the export of such raw material to ensure its own stability and integrity.

Every mineral deposit has definite boundaries, or, in other words, it is limited in length, breadth, and depth. Within these limits there is a certain amount of material that can be profitably extracted by present methode, and a further quantity that may become available in the future with improved appliances, but there will inevitably come a time when even this will be exhausted. Every mineral deposit now being worked is going through this process, a fact calling for the utmost economy in their exploitation, as well as in the conservation of their finished products, and for a critical examination of the public domain for other bodies to supply the future demand. Fifty years exhausted the bonanzas of the great Comstock lode in Nevada, and left a rabbit-warren four miles long and three thousand feet deep!

Following out this conception to its ultimate conclusion, modern civilization must perish with the exhaustion of the mineral deposits on which it is based. We are not prepared to say that unknown forces may not be discovered to invalidate the conclusion, but, unless they are, the drift of the world today is toward a return to the most primitive conditions of human life. We cannot, however, realize the possibilities of the discovery of such new sources of energy unless thay are to be found in latent qualities of the mineral elements as yet unexploited. In the meantime the centres of dense population will shift from country to country, and commercial supremacy from continent to continent, as the flood of mineral production reaches its maximum or declines in different regions.

It must not be understood from the above that the world is anywhere near such a debacle. The picture has been sketched in harsh lines and deep shadows to emphasize the overwhelming importance of the mining industry. The potential possibilities of Africa, China, South America, and other vast regions within as well as without our own boundaries, besides the steadily increasing population of the world, demands that these be made available and fostered by wise and liberal legislation, instead of being crippled by crude ideas of the meaning of the word 'conservation.' The term implies the existence of a valuable article in which both present and future generations have a vital interest; which may be used by the present possessors, if absolutely unnecessary to their well-being (but used economically and with the least possible waste), leaving the largest possible amount for the use of those to whom the remainder may descend. It is just as absurd to paralyze the industries of a nation for the benefit of posterity, when the present urgently demands the largest possible output, as it would be to tie the hands of the head of a family to save the strength for his children when they are in hourly need of his services.

There is little doubt that mining as a business is looked upon by the conservative mercantile community as a risky proposition best let alone; that in some intangible way it is different from all others, and that success is purely a matter of chance. In fact, it is and must be governed by the factors applied to other lines of effort, and these must be even more rigidly followed because of the one basic radical difference in its stock-in-trade.

In the first place, general business, in which term all industries except mining are included, is carried on under the public eye. Each unit has a stock-in-trade, the value of which is easily ascertainable, the commercial rating and integrity of each individual is known to his banker, and the purchasing public has a good general idea of the sale-value of the articles it desires to purchase. The opportunities for fraudulent operation are comparatively limited, as are also the chances of acquiring a sudden competence. Such an event would certainly be exploited by the newspapers, especially if there might be racy developments, and the general public would certainly know the fact. The merchant can buy from the manufacturer in amounts either large or small. He can begin business on a small scale, expanding from year to year, replenish his stock as required. There is no limit to expansion, if the locality has been wisely selected, except the ability of the manager to handle the establishment, which may be handed down from generation to generation indefinitely.

On the other hand, the miner starts with his capital locked up in the bosom of the earth more securely than in a safety-vault. He cannot replenish it like the fisherman, lumber-man, or farmer. Not until the last pound of ore has been sent to the surface can he tell the amount of his capital. It should be understood that no mineral deposit has anything but a speculative value when first



THE TWIN SHAFTS AND CRUSHING-HOUSE OF THE INSPIRATION CONSOLIDATED COPPER COMPANY



THE ORIGINAL MINE, FORMERLY OWNED BY W. A. CLARK, BUT NOW BELONGING TO THE ANACONDA COPPER MINING COMPANY

discovered, however great its potential value. Positive value can only be acquired by honeycombing the orebody with shafts, drifts, and tunnels so that its dimensions can be measured and the value of the material ascertained by sampling and assay; and not until it is exhausted can the balance-sheet be made up, to ascertain whether the gross yield of the resultant metal has paid all the costs of development, labor, machinery, transportation, reduction, management, taxes, insurance, and other minor expenses, or has left a deficit. Even with a showing of financial failure the enterprise may have been profitable to the nation; for whether the amount be large or small, the metal produced from the mine is an increase in the tangible assets. Executive ability of the highest order is evidently essential.

The fostering of the industry may be accomplished in several ways: by modification of national laws to ensure certainty of title, and State laws to curb the activities of fraudulent operators, and by impressing on the general public the necessity for giving it both moral and financial support. The actual mining laws as passed by the Congress of the United States cover but a few pages, while the interpretation by the courts occupy sufficient volumes to make a library. These decisions are as diverse as the one hundred and fifty creeds founded on the Bible; no better evidence of the necessity of revision is necessary.

The law of 1866 was drafted to cover the particular case of the Comstock in Nevada and granted ownership to a given number of feet on the length of the lode. Its principal result was a crop of litigation in which an army of attorneys was paid to serve or to withhold their services at a cost of millions of dollars, which should have been disbursed as dividends. At that time the knowledge of mining geology in the United States was in its infancy, and was more theoretical than practical. Titles were held largely under the regulations of miners' organizations, and varied according to local ideas of the conditions required to give a locator a valid right to his claim as regarded size and the labor question. An applicant for a patent had to file a copy of these laws or regulations, if such existed, to show that he had complied with them.

The law of 1872 was an attempt to improve that of 1866 by granting the applicant the right to a certain amount of ground, for working purposes, on each side of the centre of the lode, to and not exceeding 300 ft., nor less than 50, and made it compulsory that the end-lines be parallel, so that the length granted on the lode should remain the same at all depths. It also granted the right to follow the vein on its dip beyond the side-lines of the claim should the flatness of the dip so take it. These features might have been satisfactory if all veins followed straight lines and dipped with mathematical precision, but they take no note of the varying character of orebodies, or the vagaries of nature in the shape of faults, foldings, crossings, etc. The result has again been endless litigation, and no certainty of title even after a patent has been granted.

There is palpable need for a radical revision of laws causing a diversion of so many millions of dollars (which should have been disbursed as dividends to the mine stockholders) into the pockets of the non-producing legal fraternity. National legislation should be so framed as to make a patent to mining ground as inviolable as that granted to an agricultural homesteader; the individual States should regulate the manner in which the statutory work should be done; also the manner of recording locations and annual labor; and so amend their corporation laws as to curb the activities of the fraudulent operator, and cast some shadow of protection over the minority stockholders. Climate and the different topographical conditions in the different mining States make it difficult to equitably regulate many details in a general law. The question of what these laws should cover and how they should be worded is too great for discussion here. Suffice it to say, that clarity of language is absolutely essential. The mixed use of the words 'locator,' 'assignee,' 'person,' and 'individual' in the Alaska placer law has resulted in at least three different interpretations of its meaning.

Wise legislation surely will do more for the careful exploitation of the mineral resources of the nation than all conservation laws, which have for their basis the assumption that all men connected with the mining industry are dishonest and that all their efforts are saturated with fraud and perjury.

There was little, if any necessity, for laws governing the sale of mineral lands before the discovery of gold in California started the wave of migration westward and disclosed the existence of vast regions rich in valuable mineral deposits of which the people east of the Mississipi had never dreamed. In the eastern States the great bulk of the mineral lands had passed into private ownership, and could be handled without special legislation. The Great West was to the East an unknown quantity, and with all due respect to the force of early education, or the want of it, the ignorance of its social life and material progress is nearly as dense today as it was fifty years ago. Eastern people apparently have no conception of the problems that confront new communities living under conditions different from those with which they are familiar, and they suffer from the delusion of old age, that it knows more than its children as to what is better for them than they do themselves. They find it hard to realize that the children have grown up and may have decided views of their own. By all means let the States regulate their own affairs, in non-national matters, in the way best suited to the conditions nature has imposed upon them.

The fierce legal battles over the millions of dollars involved have been for years before the public through newspaper scare-heads and have doubtless contributed, with other causes, to the widespread impression that mining is a gamble and that success is due to chance pure and simple. It has been shown, however, that every individual in a nation has a vital interest in the continued activity of the industry; not only those whose income and daily bread are the result of mineral development, but every manufacturer who uses machinery of any kind, and every wholesale merchant, middleman, and retailer

engaged in the distribution of the manufactured products, as well as every member of the clerical force and the vast army of laborers dependent on a daily wage. No member of the community is exempt. The fact is tacitly, though in most cases unconsciously, admitted by the general acceptance of the condition of the iron and steel market as indicating the pulse of the nation's commercial prosperity.

The popular conception of the word 'gambling' as applied to mining, is that of a man sitting in a game of cards, dice, or roulette; that everything is due to chance, plus the liability of confronting a variety of crooked schemes skillfully manipulated by the promoters of the game, but that he may win a big stake if he plays long enough: Eliminate this element of chicanery from the word gamble and apply to the mining industry the same common-sense and business rules that are demanded in all other industries and they meet on a common plane. Neither can take the holier-than-thou attitude or call the other black.

The probate of their wills shows how few of the young men who face the world with their college sheepskins have made a monetary success through brains and suavity of manners. The millions of men who annually start on a manufacturing or mercantile career take the chances of being able to steer a winning course through the pitfalls of competition, lack of capital, deficient judgment in selecting a suitable location, shifting of business centre, poor financial training, inability to understand human nature, lack of persistence and quick thought in emergencies, besides other troubles that pop up unexpectedly at each turning of a corner. The small percentage of those that become captains of industry, the records of proceedings and bankruptcy, and the constantly changing occupancy of the smaller stores in the large cities, all testify to the uncertainty of success. If gambling be an attempt to secure something of value when there is a large and unknown number of factors working against the effort, then not only mining but all business is a gamble, and as some cynic has put it, "birth, life, marriage, and even death is a gamble."

Like the merchant, the miner is subject to similar conditions. In the business of each there is and has been varying degrees of sharp practice and more than a suspicion of underhand methods, but unfortunately the exploitation of mineral resources is the only one that has acquired a sinister reputation, and the eradication of this sentiment is as difficult a problem as it is to rehabilitate the character of a dog that has been given a bad name, truthfully or otherwise. The task must, however, be attempted. The industries that now withhold the helping hand must be taught how vitally they are interested. In estimating their profits, allowance is always made for bad debts and bankruptcies, and they should be prepared to assist in the support of State institutions designed to watch over and protect the interests of investors in mining enterprises during their infancy. Such watchful care is extended by Chambers of Commerce and similar organizations to other industries at the expense of the raw materials on which such industries depend for existence. There are large communities whose life depends upon the abundance of mineral production, where a man trying to finance a mine is looked upon as crazy, because, to use a Californian euphemism, he is in a 'cow-country' or an agricultural region; or a strategic point as a port-of-entry for foreign commerce.

Our merchants everywhere must be educated to the fact that mining is as honorable a business as any other, that it takes money to finance any business, whatever its character; that spectacular success of any kind is rare and is the result of good judgment and persistent effort; that it takes years to open a big mine as it took years to build up the big mail-houses or the Baldwin locomotive works, and that in self-defence they are bound to foster, in every conceivable way, the basic industry that is the foundation of all business and of the complex fabric of modern civilization.

Coal, oil, and the metals, are the materials of which this foundation is constructed. To limit their production at this date on the plea that they may be wanted in the future by posterity is folly beyond expression in words. We are fighting that we may have a balance to deliver. To limit production may cause us to fail in realizing the day when less of these absolutely invaluable things will be diverted to the engines of war, and more be made available for the occupation of peace.

Occurrence of Metals in Nature

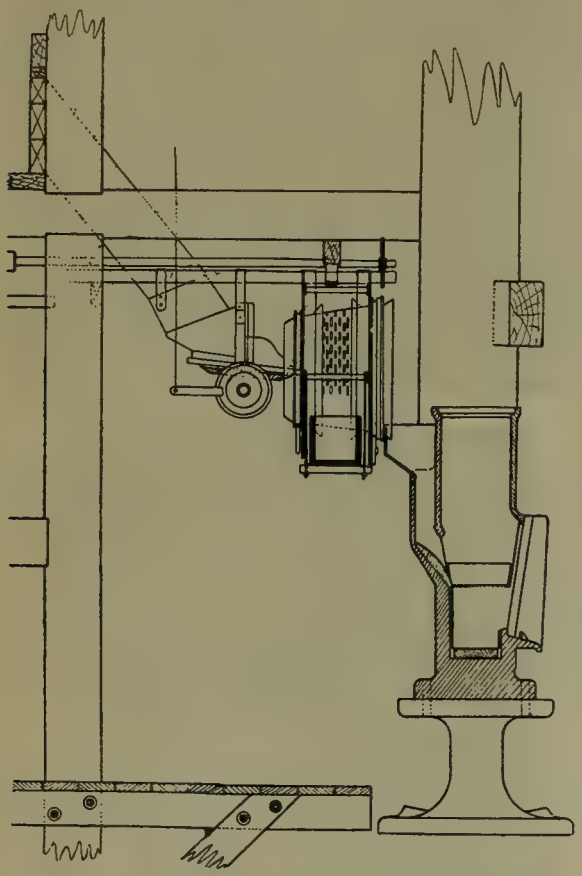
The following descriptions, while apparently elementary, are refreshing to all in the mining industry:

Aluminum as the silicate.
Antimony as the sulphide.
Arsenic as the sulphide.
Barium as the sulphate.
Bismuth as the oxide, sulphide; also metallic.
Cadmium as the oxide, carbonate, and sulphide.
Calcium as the carbonate, sulphate, and silicate.
Chromium as the oxide.
Cobalt as the sulphide.
Copper as the sulphide, oxide, and carbonate.
Gold as the metal or telluride.
Iron as the oxide, sulphide, and carbonate.
Lead as the sulphide.
Magnesium as the carbonate, sulphate, and silicate.
Manganese as the oxide.
Mercury as the metal or sulphide.
Nickel as the sulphide.
Silver as the metal or sulphide.
Sodium as the chloride and silicate.
Strontium as the carbonate, sulphate, and silicate.
Tin as the oxide.
Zinc as the oxide, carbonate, and sulphide.—E. R. Doorling in 'Chemical Engineer.'

PYRITE is now being produced as a by-product from coal mining, the pyritiferous slates, formerly thrown into the gob, being concentrated. This will add materially to the revenue at many mines that have large amounts of slate-band rich in pyrite.

By-Passing Ore From Stamp-Feeders to Tube-Mills

*Stamp-mill capacity is considerably increased by screening out the fine ore and sending it direct to tube-mills. that is, the material from the crushers finer than the screen used on the mortar-boxes. According to E. H. Johnson the device consists of a bell-mouthed trommel 21 in. long, 26 in. diameter at the narrow end, and 30½ in. at the wide end. It operates as a revolving-perforated



SECTION OF STAMP-MILL SHOWING FEEDER AND TROMMEL FOR BY-PASSING FINE ORE. THE MORTAR STANDS ON A CAST ANVIL, A FEATURE OF RAND PRACTICE.

chute between the Challenge feeder and the mortar-box. The screen on the trommel is a perforated plate with holes ⅜ by 1¼ in. The material passing the screen falls into a launder passing outside the battery king-post into a launder leading to the tube-mill cones. The effect on crushing is not only to eliminate from the mortar-box the material fine enough for tube-milling, but also avoids the cushioning effect to the stamps this material causes. The trommels are driven through an intermediary shaft from the line-shaft, and revolve at 16 r.p.m. The maintenance cost is low, the perforated screen (¼-in. plate) lasting nine months, while the only other parts requiring renewal are the small supporting rollers. The rate of feed is, of course, governed entirely by the battery-feeder.

Some time ago an opportunity presented itself to show what this by-passing amounted to, a section of the plant not equipped with the trommels being 'hung-up' for two weeks, enabling a determination of the effect of the trommels to be made. Following are the data obtained:

Stamps dropping	110
Weight of stamps, pounds	1450
Running time, days	11.2417
Ore crushed, tons	28,322
Duty per stamp, tons	22.9
Tube-mills working	11
Running time, days	12.1356
Screen-aperature, inches	0.32
Duty per nominal crushing-unit, tons*	19.74
Minus 90-mesh duty per tube-mill per day, tons	147.5
Minus 90-mesh duty per nominal per day crushing-unit, tons	4.588
Slime, per cent	56.1
Minus 90-mesh in pulp	88.1
Minus 200-mesh in pulp	74.0

*The nominal crushing-unit, familar to Rand millmen, is used to render comparison easy. For those unacquainted with this empirical formula a unit is a 1250-lb. stamp, and a 22 by 5½-ft. tube-mill is equivalent to 30 units.

Gradings:

	% +60	% +90	% −90	% −200
Screen grading	75.9	5.5	18.6	...
Sand residue	1.7	25.3	31.4	41.6
Slime residue	...	...	0.7	99.3

*Abstract from 'Journal' of C., M. & M. Society of South Africa.

PURE MOLYBDENUM is a white metal, softer than steel, malleable, and capable of being forged and welded. It can be filed and polished, and may be drawn into ribbons and fine wire. It will not scratch glass. Its atomic weight is 96. Its specific gravity varies from 9 to 10. depending upon its physical condition and the manner of its production. Its melting point is about 4500° F., being higher than for copper, iron, or platinum, and lower than for osmium, tantalum, or tungsten. The purest molydbenum is produced from wulfenite, but practically the whole of the world's supply of the metal and its compounds is obtained from molybdenite. Metallic molybdenum is only slowly oxidized at ordinary temperatures and retains its lustre indefinitely, but it oxidizes rapidly at about 1100° F. It is attacked by fluorine at ordinary temperatures, by chlorine at a dull red heat, and by bromine at a cherry red heat. Molybdenum is attacked by nitric acid, and by hot concentrated sulphuric acid, but not by hydrochloric acid.

ANTIMONY is used in enamels, glass-making, vulcanizing, and in paintings; it also constitutes 12½% of the composition of shrapnel bullets, and is employed in smoke-bombs, and in the primers of shells and cartridges. The production of antimony in the United States last year was only 10% of the total consumption. The imports amounted to 10,370 tons of ore and 17,825 tons of the metal, of which 87% came from China, and 12% from Mexico. The expansion of the domestic output is an urgent necessity.

Potash Production of the United States

The output of all potash materials produced and marketed in this country in 1917, as reported by manufacturers to the U. S. Geological Survey, was 126,577 short tons, which contained 32,366 tons, or an average of 26.4% of pure potash (K_2O). This is more than three times the quantity produced in 1916, and corresponds closely with the output predicted for 1917 by H. S. Gale, of the Survey, from a review of the mid-year statistics. The approximate average selling price of these potash materials at the points of shipment was $4.26 per unit—that is, $4.26 per ton for every 1% of pure potash (K_2O) in the material marketed. This price corresponds to $426 per ton of pure potash. The total value of the potash produced in the United States in 1917 was $13,791,922.

In the following preliminary summary by Mr. Gale, the 1917 production is classified with as much detail as is consistent with the Survey's obligation to hold individual reports of production confidential.

Sources	Producers	Production Short tons	Available potash (K_2O) Short tons	Value at point of shipment
Mineral sources:				
Natural brines	10	79,876	20,652	$8,219,912
Alunite (refined salts and crude and roasted alunite)	3	7,153	2,402	892,763
Dust from cement mills	8	13,582	1,621	700,523
Dust from blast-furnaces	3	2,133	185	68,841
Organic sources:				
Kelp	10	11,306	3,572	2,114,815
Molasses residue from distilleries	4	8,589	2,846	1,130,907
Wood ashes	36	700	424	406,856
Evaporated Steffens water from sugar refineries	5	*2,593	359	143,430
Evaporated wool washings and miscellaneous industrial wastes	3	645	305	113,875
	82	126,577	32,366	$13,791,922

*Includes 1333 tons of material produced but not sold in 1917.

The output of one of the four plants producing potash from brines in western Nebraska considerably exceeded that from any other source or district, and the combined output of these plants represents 45% of the total for the entire country. Searles Lake, California, was the other source of large production from brines.

The potash produced from kelp represents 10% of the total. A large part of this was high-grade potassium chloride produced by two companies, while the remainder was divided among eight other producers, who manufactured kelp char or ash carrying 16 to 36% of potash, used as an ingredient of fertilizer. An unexpected shortage of the kelp crop curtailed production from this source in 1917.

Production from alunite was not so great as had been expected, though two additional producers from this source entered the field. The plant of the original producer (Mineral Products Co. at Marysvale, Utah) was destroyed by fire in October, and, though the work of reconstructing it has been pushed rapidly, it had not been put into operation by the end of the year. (It is now working, May 1918.) In addition to the high-grade potassium sulphate produced from alunite a considerable quantity of calcined alunite carrying 16% of available potash was marketed for incorporation into fertilizers, and raw alunite was shipped to Eastern reduction works to be treated for the recovery of potash.

A fairly high-grade potash produced from the residue of charred molasses at alcohol distilleries, representing nearly 9% of the total output, was, like kelp char, used in fertilizer mixtures.

The quantity of potash recovered from the waste liquors produced by the Steffens process of beet-sugar manufacture was somewhat augmented in 1917. Many experiments designed to increase the output from this source are being made at beet-sugar factories throughout the country.

Eight cement mills reported production of potash salts or of potash-rich dust sold as fertilizer during the year, the quantity marketed from this source reaching a total of 13,582 short tons, representing 1621 tons of actual potash (K_2O). The recovery of potash from cement dust, which is being rapidly extended, seems to offer large promise for a greater domestic potash industry, and it is expected that the production from this source may take second place in the summary by sources for 1918. (This material is collected by means of the Cottrell electric precipitator.)

Dust collected from blast-furnaces is a significant though still a minor item in the total for 1917. Production from this source may eventually be large.

Crude potash is still produced by the old methods of leaching from wood-ash in the hardwood lumber districts, chiefly in Wisconsin and Michigan. Complete statistics of this output are difficult to obtain. Reports from 36 producers in 1917 show a gross output marketed of 700 short tons, having a value of $406,856. This is assumed to be about 424 short tons of K_2O.

Refined potash salts were produced from wool washings in 1917 by at least two plants, and some potash was produced from the ash or char obtained by burning other waste organic matter at several industrial establishments.

Potash was produced in 1917 by 82 firms, including 36 wood-ash leachers, most of them operating small works. The total production is about 13% of the normal consumption of potash in the country during the years immediately preceding the War. There is now no crisis as regards the potash supply of the country, though the prices paid for what is obtained are about ten times the normal prices before the War. All firms have been seriously handicapped by shortage of labor and fuel, difficulties of transportation and inability to get needed equipment. Potash-producing plants have been generally included among the industries that are necessary to win the War, and there is a widespread sentiment in favor of assisting, so far as possible, the operations of these plants by giving special consideration to their actual needs. It is exceedingly unlikely, however, that Government operation or any direct Government financial aid to new enterprises for producing potash will now be considered necessary, in view of the successful results obtained from the many privately-conducted projects.

Sulphur, Pyrite, and Sulphuric Acid in 1917

SULPHUR. Sulphur was produced in 1917 by eight mines, one in Louisiana, two each in Texas, Nevada, and Wyoming, and one in Colorado. According to the U. S. Geological Survey the production in 1917 was 50% greater than in 1916, and the indications point to a still further increase in 1918.

Statistics received from the Bureau of Foreign and Domestic Commerce show that 973 long tons of sulphur was imported into the United States in 1917 and that 152,831 tons was exported. Imports in 1917 were less than 5% of those in 1916, but exports were more than 18% greater than in 1916, and were the largest ever made from this country in a single year. The total value of the sulphur exported in 1917 was $3,504,661, which would indicate an average value of $22.93 per ton.

PYRITE. The pyrite industry showed an unsettled condition in 1917, due largely to uncertainty as to whether importation of foreign pyrite would be continued. In spite of this uncertainty, however, the domestic production was about 10% greater than in 1916. Statistics collected by the Survey show a total production of 462,662 tons, valued at $2,485,435. The two States making the largest output were Virginia and California, which together produced nearly 300,000 long tons.

The quantity of pyritic ore imported last year was notably less than that imported during the years preceding the War. The total imports of pyrite in 1917 was 967,340 tons, valued at $5,980,457. Of this, 214,115 tons came from Canada and Newfoundland, and 753,225 tons from Spain and Portugal. The principal cause of the decline in the imports was the difficulty of obtaining ships to bring ore from Spain. An increase in the imports of pyrite from Canada is expected in 1918, but on the other hand, a still greater decrease in imports from Spain is probable.

SULPHURIC ACID. The quantity of sulphuric acid produced in 1917 was nearly twice as great as that produced in 1913, which may be taken as a normal before-the-War year.

The output of sulphuric acid last year, expressed in terms of acid of 50°B., was 5,967,551 short tons, valued at $71,505,536, to which must be added 759,039 tons of acids of strengths higher than 66°B. (which cannot be calculated for comparison with acid of 50°B.) valued at $16,034,545. The increase over 1916 in the production of acid expressed as 50°B. was therefore more than 325,000 tons and $8,800,000 in value, and the increase in the production of stronger acids was more than 315,000 tons and $5,225,000 in value. The value of the total production of the acid in 1917 was over $14,000,000 more than in 1916.

The foregoing totals include by-product acid—that is, produced at copper and zinc smelters. The yield from this source in 1917, expressed as acid of 60°B., was 1,336,209 tons, valued at $14,516,104, to which must be added 119,048 tons of strengths higher than 66°B. (which cannot be calculated as acid of 60°B.), valued at $2,374,341.

Statistics collected by the Survey show that 221 plants in 33 States produced acid in 1917. Of these, 139 made acid of 50°B., 66 acid of 60°B., 60 acid of 66°B., and 38 acid of higher strengths. Pennsylvania and New Jersey made acid valued at more than $10,000,000 each, and Virginia, Maryland, Illinois, and Georgia each acid valued at more than $5,000,000. The value of the total production of these six States amounted to over $50,000,000, or considerably more than half of the entire value of the acid produced in the country.

The following quantities and kinds of sulphur ore were used in making sulphuric acid in 1917, in tons:

	Domestic	Foreign	Total
Sulphur	463,364	20,463	483,827
Pyrite	376,955	880,183	1,257,138
Gold and silver-bearing pyrite and galena	17,380	.....	17,380
Copper-bearing sulphides	708,502	147,531	856,033
Zinc-bearing sulphides	584,100	152,811	736,911

Statistics received from the Bureau of Foreign and Domestic Commerce show that 4287 tons of sulphuric acid, valued at $98,232, was imported into the United States in 1917, and that 31,771 tons, valued at $1,600,125, was exported.

Standardization of Deci-normal Sulphuric Acid

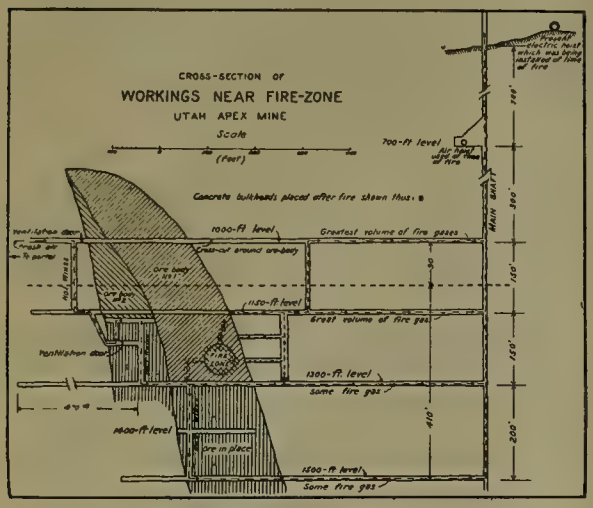
The best procedure, according to F. W. Babington and A. Tingle (Jour. Soc. Chem. Ind.), is to select a suitable acid and compare its solutions volumetrically with the acid to be standardized. Either tartaric acid or salicylic acid is suitable for this purpose. Both are cheap, readily obtained in a state of purity, both have high molecular weights, are anhydrous, and keep well when dry. Salicylic acid can be used only in alcoholic solution, and tartaric acid is subject to change if the solutions are kept too long. To 25 cc. portions of a standard solution of H_2SO_4, the following methods were applied: (1) titration in comparison with tartaric acid; (2) titration in comparison with salicylic acid; (3) direct precipitation with $BaCl_2$; (4) direct precipitation with excess $Ba(OH)_2$; (5) exact neutralization with $Ba(OH)_2$, using phenolphthalein; (6) evaporation of $Ba(OH)_2$ with excess of acid and calculation from the titration; (7) addition of excess H_2SO_4 to $Ba(OH)_2$ and filtration with calculation from titration. The corresponding amounts of $BaSO_4$ obtained were, in grammes, 0.2924, 0.2924, 0.2949, 0.2915, 0.2735, 0.2868, and 0.2837, respectively. In the standardization of solutions, 0.1 normal or weaker, any method involving the weighing of $BaSO_4$ is liable to a larger experimental error than is titration, since 0.1 cc. 0.1 N acid is equivalent to 1.17 mg. $BaSO_4$. The results from (1) and (2) are probably correct, judging from the concordance with each other and with those from (4); the result from (3) is low because of the occlusion of $BaCl_2$; incomplete precipitation is the cause of loss in (5); the presence of an alkali silicate would best account for the discrepancy among (4), (6), and (7).



BINGHAM, UTAH

Fire Problems at Utah Apex Mine.—Montana-Bingham and Utah Metal Reports.

Engineering problems encountered during the fire at the Utah Apex mine late in March 1917 were recently described by V. S. Rood and J. A. Norden—manager and assistant superintendent for the company—to the Utah Society of Engineers at Salt Lake City. From a 3-compartment shaft, levels had been driven to the orebodies. The 1000-ft. level, about 4000 ft. long, was a haulage and drainage-adit. Other workings are down to 1500 ft. Ore carries lead, gold, and silver. The orebody is mostly in a crushed and faulted limestone, also sometimes in lenses of black pyritic shale. In mining above 1000 ft. regular square-set and filling methods were used, but with indifferent success. The filling—limestone, shale, and pyrite—swelled, oxidized, and produced considerable heat. Extraction above 1150-ft. level was afterward done successfully by top-slicing. The caved material and mat of timber produced some heat, but of no consequence. On 1300-ft. level, square-sets were tried again. Although ventilating raises were put up, the filling became as hot as 98°F., even where there was plenty of air. Top-slicing was also used here on several ore-shoots, but slices frequently broke through the thin walls of the stopes, exposing the heating filling of the old stope. Early in 1917 the 1500-ft. level cut the orebody, and in March it was being prepared for stoping by sluicing, when No. 11 raise emitted odors that showed the mine to be on fire. After considering the problem, it was decided to flood the mine to the 1100-ft. level. About 15,000,000 gal. of water was forced into the workings from March 27 to April 10. Unwatering was done by bailing from April 20 to May 27. After cleaning up the levels, concrete bulkheads were placed at all openings leading to the fire-zone. The total cost of combating the fire was $42,884.

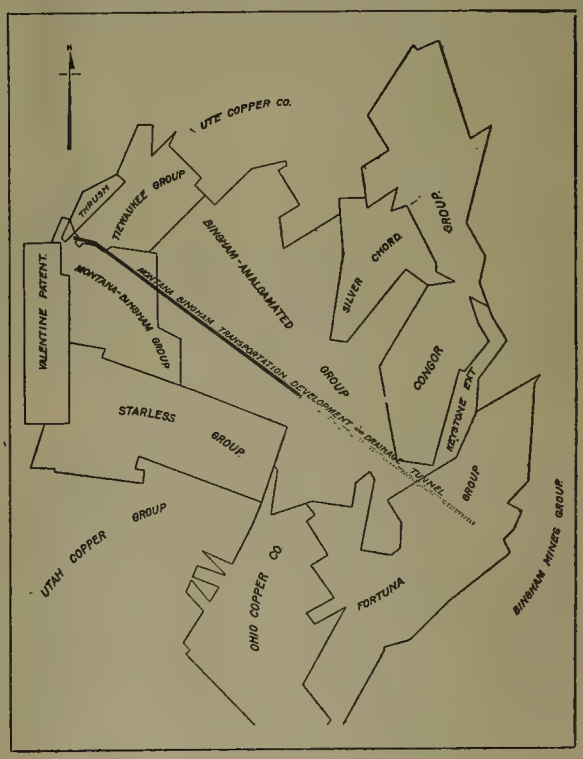


PART OF UTAH APEX MINE, SHOWING FIRE-ZONE

The Utah Metal & Tunnel Co. has issued its report for 1917, showing the following comparison of results:

	1917	1916	1915
Gold, ounces	4,612	17,934	16,914
Silver, ounces	242,003	388,757	475,894
Copper, pounds	659,127	1,761,520	2,873,815
Lead, pounds	5,348,610	6,301,670	9,860,089
Gross value	$ 884,688	$1,499,268	$1,386,845
Net profit	40,993	528,737	.....
Balance at end of year	1,057,492	1,511,949	.....
Dividends paid	553,262	342,473	.....
Current assets	233,434	774,117	.....
Current liabilities	51,093	66,662	.....

Operations were handicapped in many ways during the past year. The great need of this property is development. Adjacent properties have given good results, so should the Utah Metal mines. At least six lime-bed formations exist, in which mineral deposits are expected to be found. A large quantity of high-grade lead ore has been opened in one, but the claim is in dispute. In the Utah Metal and Bingham-New Haven ground large tonnages of low-grade lead ore has been developed. The mill has now 300 tons capacity.



PART OF BINGHAM DISTRICT, UTAH

Montana-Bingham Consolidated Mining Co. has issued a report showing its condition at April 1, 1918. Property consists of the Fortuna claims of 171 acres, Eddie of 50 acres,

Tiewaukee of 45 acres, and Thrush and Valentine of 46 acres. Company owns 20% of issued shares of Bingham Amalgamated Mining Co. In the Fortuna claims three tunnels have been driven, but the best development is in the Mayflower where 1000 ft. of ore averages 2% copper. A 150-ton flotation mill and full mining equipment is in use here. On the Bingham side of the property, at the Thrush, a 7 by 7-ft. transportation tunnel has been driven 5900 ft. This is 600 ft. below Keystone tunnel of the Fortuna. The Bingham Coalition Mines Co.'s 150-ton mill is to be leased and improved. With the two mills a profit of $18,000 monthly is calculated upon. Other developments are entirely satisfactory. Excess of liabilities is $506,024, but directors do not consider this serious. On May 8 an assessment of 10c. per share was to be levied. This will yield $230,000.

ELY, NEVADA

Liberty Loan Subscriptions.—Consolidated Coppermines Finds Rich Ore.—Coal-Dust Firing at McGill.

It is claimed that Nevada stands at the top of all the States for total over-subscription to the third Liberty Loan, also by the greatest number of individual subscribers—24,000—out of a population of 111,000. In one of the store windows at Ely there is on display the Honor Flag, with four stars, given to White Pine county by the Government for over-subscribing the loan four times.

Consolidated Coppermines is operating both units of its mill. In drilling for air recently, near the old caved Alpha shaft, a large body of copper carbonate ore was discovered. This is at 400 ft. depth; heretofore none has been found above the 700-ft. level. Considerable high-grade ore is being taken out from the 11th and 12th levels, a continuation of the rich shoots on No. 7 and 10, which was mined last year.

The Ward mine is shipping 45 tons daily of a lead-silver ore.

Little manganese ore is being shipped lately, as the pockets have been exhausted.

There is about 600 tons of lead-silver ore at Hamilton, which is being hauled to Kimberley for shipment to smelter.

Nevada Consolidated's fine new coal-crushing plant erected last year, was recently put in operation. Previously sufficient coal could not be obtained, and the company had to continue using fuel-oil at high cost. The new system saves over $1 per ton of ore milled.

VICTORIA, BRITISH COLUMBIA

Coal Production and Use of Powdered Coal.

Coal production of British Columbia in April totaled 224,992 tons. Vancouver Island collieries yielded 148,078 tons, Crow's Nest Pass 62,641 tons, and Nicola-Princeton 14,253 tons. The total for 4 months is 77,272 tons ahead of the same period of 1917. Two new mines will be producing 500 tons daily each by the end of the year, namely, those of the Granby Consolidated and Canadian Collieries.

The use of powdered coal to replace fuel-oil is being tried in this Province at present. At Vancouver the B. C. Sugar Refining Co., one of the largest of the Province's industries, has erected a plant to provide for the change and, it is understood, is getting satisfactory results. The Canadian Collieries (Dunsmuir) Ltd., anticipating a demand for the new fuel, is making tests of waste from its washery that has been accumulating for years in the harbor at Ladysmith. If results are satisfactory the company will put in pulverizing equipment and will proceed with the reclamation of this refuse, of which there must be four or five million tons, some of which has been lying under water for 17 years. It is considered probable that, should the experiments turn out well, and providing the United States withdraws the 'oil-tankers' at present in service between California and British Columbia, the Canadian Pacific Railway will arrange for the use of coal-dust in locomotives now burning oil.

An interesting sidelight on the increased value of coal in the Canadian North-West is obtained from an experience of the Pacific Coast Coal Mines Co. In pre-war days the company discharged its waste into a lagoon, across which a rough cofferdam had been constructed. George Wilkinson, then manager, and now Inspector of Mines for British Columbia, was responsible for this. His idea was that this coal, for which there then was no market, might prove useful in an emergency. Last year 50,000 tons of it was recovered and placed on the market at $3 per ton.

A new company, known as the Canadian Western Fuel Co., has been incorporated here for the purpose of taking over and operating all the assets in British Columbia of the old Western Fuel Co. of San Francisco. The incorporators are G. W. Owen, J. B. Owen, and John Hunt, and the capital is $5,000,000. There will be no change in the management as at present constituted, and its headquarters will be at Nanaimo. G. W. Bowen is general manager and John Hunt remains as general superintendent. J. B. Bowen is manager for the Western Mercantile Co., the trading establishment opened by the Western Fuel Co.

The Fuel Controller for Manitoba, T. R. Deaville, is quoted as accusing the coal-mine operators of British Columbia, Alberta, and Saskatchewan as being strangely lacking in business sense and a spirit of co-operation in not starting a campaign with a view to explaining to the people of the Province of Manitoba the quality of the coal of the Western provinces and giving directions as to the best methods of handling and burning it.

An advance in the selling price of coal in British Columbia is expected. That an application to the Fuel Controller for sanction for such a course was expected following the latest increase of 50c. per day granted the coal miners. It is predicted that the increase will be between 50 and 65c. per ton.

Dorreen.—At least $150,000 will be spent on development of the Fiddler claims situated near here in the Skeena mining division. A considerable proportion of this will be expended this year. It is understood that the Oppenheimer interests of Butte, Montana, are advancing the money, and it is confidently expected that the property will be placed soon on the shipping list. It is situated in the neighborhood of the Rocher de Boule. The ore carries chiefly gold, about $30 per ton.

LEADVILLE, COLORADO

Labor Situation.—Gold and Manganese.

Labor is rapidly becoming a serious problem here. Following the strike of last year, hundreds of miners left the district for the copper centres of Utah, Arizona, and Montana. Since then more than 300 young men, mostly employed at the mines, have entered military service, and another quota of 100 has been called to leave between May 26 and June 1. The June quotas have not been announced, but it is believed that another large number will be called out during that month. In a town of 10,000 people, where mining offers the main field of employment, requiring the services of approximately 2000 men, these inroads in the available labor supply cause serious results, from a purely mining point of view, and unless offset by some other source than is now known, they will cause a material reduction in production. The Leadville Chamber of Commerce is to take the matter under consideration for the purpose of assisting local operators to secure labor.

The Miller gold mine in Lackawanna gulch is being reopened for the season, in charge of G. W. Buehler.

On Poverty Flats the Jason, Albright No. 2, and Fairview are producing a considerable quantity of manganese ore, 100 tons daily.



ALASKA

Kennecott.—The Kennecott Copper Corporation is to hold 51% of the capital of the Mother Lode Coalition Mines, the new company formed to take over the Mother Lode Copper Co. The 2,500,000 shares will have no par value.

The 1917 report of Kennecott Copper Corporation has been issued, containing the following:

Copper and silver sold realized $16,026,105. The cost of production was $4,208,909. Dividends from Utah Copper and other income made a total of $19,283,481 available, less $1,318,579 for taxes and interest, leaving $17,964,902 profit. Dividends absorbed $10,311,665. The balance on December 31, 1916, was $18,915,228, and a year later $8,596,444. Depletion charges for 1916 and 1917 totaled $17,618,574. Current assets total $11,280,796, and liabilities $1,508,419. Investments are valued at $102,568,396.

New development amounted to 10,770 ft. at Kennecott and 5320 ft. at Latouche; also 14,419 ft. of drilling. Labor was short, and a strike was declared for 47 days at the Bonanza and Jumbo mines, the men demanding more wages. A new double-compartment shaft was completed to 600 ft. at the Bonanza, also additions to the power-plant. Storage-battery locomotives and self-dumping ore-cars were installed underground at Latouche, and the mill and power-plant improved. Operations resulted as under:

	Kennecott mines	Latouche mine
Ore shipped to smelter, tons	89,799	49,141
Copper content, per cent	38.57	11.48
Ore concentrated, tons	206,253	253,805
Copper content, per cent	8.92	2.06
Concentrate, tons	29,559	29,423
Copper content, per cent	53.52	14.20
Recovery, per cent	85.98	80.28
Tailing leached by ammonia, tons	98,075	.....
Copper content, per cent	0.90	.....
Total recovery, per cent	89.40	.....
Copper produced, pounds	78,211,429	
Silver produced, ounces	933,573	
Cost of copper sold and delivered, cents per pound	5.38	

The company has declared a quarterly dividend of $1 per share.

A discussion of the geology of the Kennecott region appears on page 785 of this issue.

Nome.—Telegraphic advice on May 30 stated that the ice on Bering sea was breaking up, and navigation to Nome could start at an early date.

ARIZONA

Copper production of this State in April aggregated 76,228,000 lb. This is from 15 large mines and a number of small ones.

Patagonia.—The World's Fair mine in the Harshaw district has been sold to Eastern people. A. A. Holland is now sampling it for the purchasers. About 15,000 ft. of development has been done. Production is said to be $1,000,000, from copper, lead, gold, and silver ores. Reserves are considered to be at least half of this amount.

Wenden.—Rich copper has been opened in the east drift from the shaft of the Little Giant. It is 18 in. of copper glance.

Several Globe men have taken a lease on the Wenden Copper Co.'s property. Three carloads of ore has been shipped.

Yuma.—Additions are being made to the Red Cloud mill, which is working at full capacity. The company is said to be employing 300 men.

CALIFORNIA

Downieville.—Mining in the northern part of Sierra county is said to be much more active than last year. Miners receive $3 per day plus board, or $4 without board.

French Gulch.—The Black Toms Mining Co. has driven an adit 1900 ft. on the Niagara ground, and has struck a heavy flow of water. The adit is 450 ft. below the lowest workings of the well-known Niagara mine. Earl J. Barnes is superintendent.

Lewiston.—The Bablew Mining Co. is driving an adit to prospect the river channel on the Paulsen ranch. Hydraulicking has been stopped on account of shortage of water.

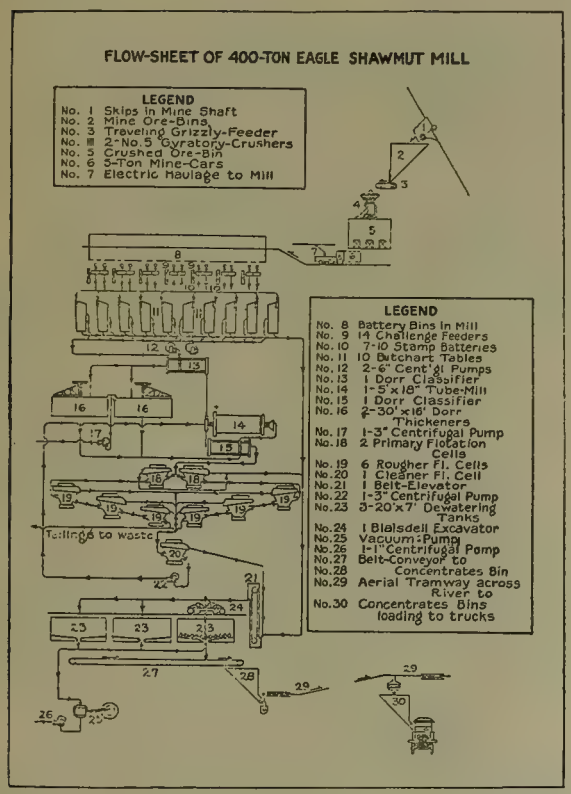
Peanut.—A carload of chrome was shipped from here by way of Redding to Chicago. It is said to be the richest chrome ever mined in this part of the State, the ore carrying 55% Cr_2O_3.

Portola.—Main shaft of the Walker copper mine is down 425 ft., in ore all the way from the 300-ft. level of the main tunnel, which is in 1000 ft. This ore carries 5% copper and $3 in gold and silver. The mill is concentrating (flotation and tables) 90 tons daily, saving 97%. Concentrate contains 21% copper, and 1400 tons await shipment. V. P. Hart is manager.

Shawmut.—Included in the Tonopah Belmont Development Co. of Nevada report for 1917 is a statement of operations of the Belmont Shawmut Mining Co., which took over the Eagle Shawmut mine in Tuolumne county. E. F. Williamson is superintendent.

During the past year the main three-compartment shaft was sunk and heavily timbered from the 16th level to a further depth of 409 ft.—from 1834 to 2243 ft.—measured from the adit-level; and the new 17th and 18th levels were turned off the shaft at 150 ft. and 350 ft., respectively, below the 16th level. Stations and ore-pockets were cut on No. 16, 17, and 18 levels, and the two latter were driven. On the adit-level a large room was excavated and timbered, and a large electric hoist installed. An underground headframe was built in a suitable excavation, and new skips, cables, and an electric-bell signaling system were installed in the shaft. An adequate electrically driven pump was put in on No. 16 level, and a smaller pump on No. 18, these being connected to pumps on the levels above by proper water-columns. Power-transmission cables connecting up the hoist and pumps were installed. A large amount of work was done on general repairs underground. Old stopes

were put in shape for production, levels that had been crushed were opened and timbered, ventilation connections made, etc. Development has not been, and cannot be, of a character to definitely block out reserve ore. The drift levels cannot be driven on the ore but must, because of heavy and caving vein material, be carried in, or partly in, the firm hanging wall, and the full extent of the ore can only be determined by cross-cuts from drift to foot-wall. The lenticular character of the sulphide ore would necessitate too many of these cross-cuts to fully expose the ore. The main sulphide ore-shoot has been, therefore, but partly developed by the work on No. 17 and 18 levels. From that completed, however, it is believed that the main sulphide ore-shoot, on the horizon of No. 18 level—350 ft. on the dip below No. 16—contains not less, in tonnage and grade, than the average of this shoot on the upper horizons. The



work on the lower levels has, moreover, shown considerable quantities of schist ore, and the new work, as a whole, has met expectations, and has doubtless increased the indicated ore-reserves to double those of March 1, 1917, or to about 318,000 tons. After a great deal of laboratory work on the ore, a process of combined gravity and oil-flotation concentration was devised. For comparison, an actual mill-test of the formerly used amalgamation and gravity concentration process was carefully made, and from the results obtained gravity concentration followed by oil flotation was decided upon, and the re-modeling of the old 100-stamp plate and vanner mill was undertaken. The design follows the flow-sheet shown. The difficulties in re-modeling of an old mill have in this case been largely overcome and the completed plant will be, while not so well arranged as a new plant, perhaps, a convenient and satisfactory mill. Seventy of the original 100 stamps will be used, and the daily capacity is expected to be 400 tons.

Gold production was expected to be started in May 1918.

COLORADO

Gladstone.—The season of 1918 will be marked by extensive development in this district, judging by present indications. A number of old claims are to be re-opened, and various mining interests are paying attention to the district, which has produced rich ore. One of the main handicaps to development is climate; at present snow covers the larger portion. The Ariadne will be among the old mines to be operated.

Silverton.—During April and the first part of May ore shipments were comparatively light due to low temperatures and a heavy cover of snow. The past winter has been exceptional, in that there has been no long period of total inactivity, as in previous years. The high prices of metals, and particularly the favorable climatic conditions, have been conducive to extensive development, also to steady shipping. During April, 60 cars of ore were shipped.

The Anvil Leasing Co., operating the Emerald vein, is making steady shipments of good copper ore, having billed out seven cars so far.

The Silver Lake Mines (S. D. & G. Leasing Co.) has resumed normal operations, and is sending large quantities of ore to the North Star mill for concentration. Some shipments of crude ore have also been made.

The Mayflower Leasing Co. is shipping large quantities and will soon be producing the normal heavy tonnage of the summer season.

The Dora Consolidated M. & M. Co. shipped a car of ore, after a short period of development.

IDAHO

Adair.—The Big Elk Mining Co. has given control of its property to S. B. Holbert of Pittsburgh, Pennsylvania. He will spend $25,000 in development, in return receiving a share consideration. A lower adit is to be driven.

Kellogg.—The Douglas zinc mine on Pine creek, operated under lease by the Anaconda company of Butte, has been returned to its owners. It is considered that transportation difficulties were the cause of this action, the wagon-road being almost impossible, and the O.-W. R. & N. Co. is not proceeding with construction of the line down Pine creek. Anaconda has shipped a total of 198 carloads of ore, assaying 25% zinc, 8% lead, and 5 oz. silver. Over 100,000 tons is said to be available. The Anaconda company left the mine in good order. A. McCullum is now in charge.

MICHIGAN

Houghton.—Calumet & Hecla pays $15 per share on June 14. This makes $25 for the current year.

Effective June 1, Copper Range Co. increased miners' pay to $4.25 per shift, pickers $4, and trammers $3.85. All bonuses are to be discontinued.

Allouez pays a dividend of $1.50 per share on June 26. This makes $4.50 for the year.

MISSOURI

Joplin.—The ore market was much stronger last week. The output of the region was 4860 tons blende, 110 tons calamine, and 1134 tons lead, averaging $54, $35, and $85 per ton, respectively. The total value was $362,304, making $9,937,885 for 21 weeks. Missouri contributed $117,914 to last week's total.

MONTANA

Butte.—Davis-Daly Copper Co. made a profit of $266,548 during the first quarter of 1918, against $144,474 in the last quarter of 1917. The output was 19,778 tons of ore, yielding 2,688,150 lb. copper, 205,650 lb. lead, 438,253 lb. zinc, 159,497 oz. silver, and 133 oz. gold. In the previous period 11,891 tons was mined. The Colorado mine will soon be producing 300 tons daily.

The Butte Copper & Zinc Co. made a gross profit of $226,717 for the first quarter of 1918. Half of this goes to the Anaconda company. Manganese shipments totaled 8300 tons. At present the daily output of this ore is 200 tons, also 100 tons of zinc ore.

Dillon.—The Crystal Graphite Co., which operates a deposit of vein graphite 16 miles from this place, made a marked increase in production in 1917. Numerous small veins, the thickest measuring 16 in., have been worked. The veins consist of practically pure graphite, though here and there they contain a little quartz. Most of the veins show bladed crystals of graphite normal to the walls of the vein. More rarely the graphite consists of fibrous material like the best Ceylon grades.

NEVADA

Carson.—The State Mine Inspector, A. J. Stinson, is reported to be enthusiastic about the mining outlook of Nevada. He has recently been inspecting the southern parts of the State. Labor is scarce. Ely is very busy. Eureka, Battle Mountain, Halimton, Mill City, Copper Canyon, Yerington, Las Vegas, and Wonder all have something new to report. Charles Huber, deputy inspector, reports excellent results in western districts.

Goldfield.—Red Hill Florence has 300 tons of ore worth between $50 and $70 per ton ready for shipment, which is to be started soon. The 300, 400, and 500-ft. levels are all showing good ore.

Grandma Consolidated's shaft is still in quartz at a depth of 790 ft. Seams in the quartz are said to show zinc by analysis.

Goodsprings.—Yellow Pine Mining Co. pays 6c. per share, equal to $60,000, on June 15. This makes $120,000 for the current year. The company took $25,000 in the third Liberty Loan, making $100,000 invested in the three loans.

Rochester.—On July 1 Rochester Mines Co. pays its first quarterly dividend of 2c. per share, equal to $40,000. The mill is treating 190 tons of $11.50 ore daily.

Virginia City.—The Comstock lode is now producing about $50,000 of silver and gold per month, nearly all from the north-end group. Last week the Mexican mill treated the following:

Mine	Tons	Value
Con. Virginia	293	$25.70
Mexican	190	41.85
Sierra Nevada	18	31.96
Union Con	205	23.72

OKLAHOMA

Picher.—Production of the mining districts last week was 3136 tons of blende and 862 tons lead, valued at $244,390.

Two years ago there were only a couple of mines in this district, with a few people employed. Now there are 10,000 inhabitants in the town, and over 15,000 in contiguous territory. Over 100 mills are at work within a radius of 1½ miles. In the whole Oklahoma mining region there are 148 mills at work, 40 are under construction, and 25 are planned.

TENNESSEE

Copperhill.—The Tennessee Copper Co. reports as follows for 1917:

An operating profit of $1,346,082 was made. Of this, interest and depreciation absorbed $434,833, leaving $911,149 net. To this is added $1,717,884, surplus from 1916, making $2,629,034 available. From this there was taken $733,631 to cover settlement of sundry claims and losses, leaving $1,895,403 carried forward to 1918. Current assets total $3,143,650, and liabilities $2,661,214. The net bonded indebtedness is $1,470,099. The reserve for possible liability under the Russian contract in dispute is $1,140,000.

The general manager, Arthur L. Tuttle, states that 12% of the men employed are in the Army or Navy. Development amounted to 3107 ft. in the Burra Burra, London, and Polk County mines; also 3351 ft. of diamond-drilling. The latter cost $2.31 per foot. The Burra Burra shaft was retimbered and overhauled at stations. Sixty-five-pound rails were laid, 6-ton skips installed, and a 3-ton electric locomotive was started on No. 8 level. A new steel head-frame and crusher-house were erected. This mine is in excellent physical condition. Reserves were increased by 498,792 tons. At the London mine compressed air superseded steam for hoisting, etc. The shaft was completed to No. 7 level. Results at the Polk County were not very promising. Reserves in all mines total 3,485,713 tons available, and 255,000 tons broken in stopes. Underground work cost $1.30493 per ton.

At the smelter new tops were put on three furnaces, a No. 2 Great Falls converter set up, a new sample-mill erected, and flues were repaired. Coke cost $9.93 per ton, more than double normal prices. There was reduced 671,015 tons of charge, including 457,902 tons of company ore and 39,275 tons of outside ore. Coke used was 6%. Smelting cost $1.63085 per ton of ore and converting 0.0585c. per pound of copper. Company ore yielded 10,547,708 lb. copper, 59,049 oz. silver, and 197 oz. gold. The cost, including administration, etc., was 16.6c. per pound of fine copper.

The two sulphuric-acid plants made 262,858 tons of 60° acid, against 181,637 tons in 1916. The Hospital, Y. M. C. A., and Commissary Departments did good work.

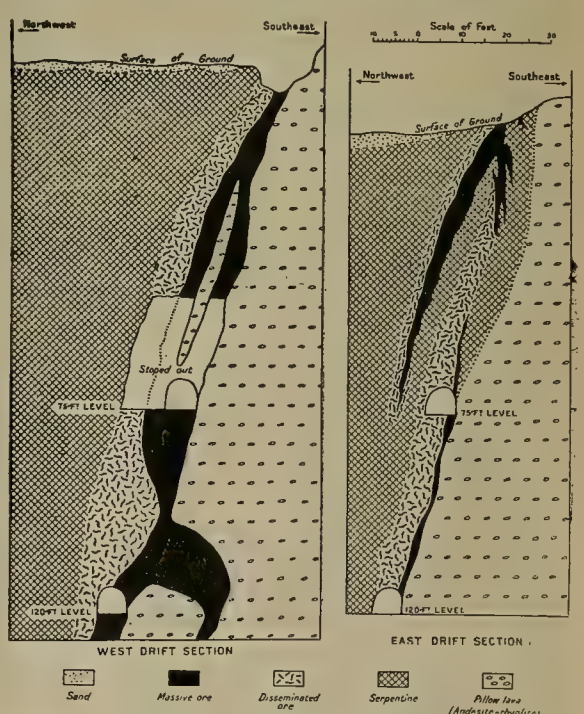
CANADA

Manitoba

The Pas.—At the Rex gold mine the new mill is in operation, and prospects are fairly good.

British Columbia

Alexo.—The Alexo mine shipped 5790 tons of nickel ore during March. This property is 150 miles north of Sud-



SECTIONS ALONG EAST AND WEST DRIFTS, ALEXO MINE, ONTARIO

bury and 25 miles north-east of Porcupine, on the T. & N. O. railway. The deposit was discovered by Alex Kelso in 1908. Shipments are made to the Mond Nickel Co.'s smelter at Coniston. Development below the 120-ft. level is under way. In the 26th annual report of the Ontario Bureau of Mines the deposit was described by M. B. Baker of Queen's University, Kingston, Ontario.

Cobalt.—Output of the Cobalt district during April is estimated at 1,520,000 oz. of silver.

A fault in the formation at a depth of 500 ft. has been encountered in the Genesee. In small fractures along the fault occurs secondary deposits of calcite containing ruby silver. Keen interest is being taken in the work now proceeding, as this formation appears to indicate the close proximity of a silver-bearing vein. As yet this part of the district has not been productive.

Kirkland Lake.—Erection of a 150-ton mill for the Kirkland Lake Gold Mines has been started.

Sudbury.—A cage-tender at No. 1 mine of the Mond Nickel Co. has been sentenced by the Court to three months in jail plus a fine of $50 or another month. His trouble was neglect to pull back the chairs in the shaft at No. 11 level. This 2-compartment shaft is 2600 ft. deep, with levels 300 ft. apart. He said he had done this and sent the cage back to No. 12 from an upper level. On reaching No. 11, the cage stopped and 300 ft. of slack wire rope coiled on top and looped over into the adjoining compartment. Meanwhile, over in this compartment a cage with 10 men was being hoisted from the 12th level. After passing No. 11 the rising cage became entangled in the cable which had looped through from the other compartment, and at 100 ft. above No. 11 the coiled cable became taut and the hoisting cable, despite the fact that it had a breaking strain of 67 tons, snapped at a point 40 ft. above the cage. The coiled cable had also coiled around the dogs, preventing the safety-catches from working. At the same time so tightly bound had the cable become that it served as a brake between the dogs and the guides so that the cage merely slid gently back down 200 ft., and there, 200 ft. above the 2600-ft. level, it became wedged. None of the occupants of the cage was injured.

Obituary

Edgar A. Collins died of pneumonia on June 3 at Ben Lomond, California. He had but lately returned from Siberia and had just begun to work with Albert Burch in the investigation of chromite deposits for the U. S. Bureau of Mines. A young and vigorous man, he gave promise of a long and useful career. He was the son of J. H. Collins, a Cornishman of distinction, known as a teacher and investigator far beyond the confines of the 'old county.' His eldest brother, Arthur, was assassinated at Telluride in 1903. Another brother, Henry F., is well known as a writer of a standard book on silver-lead metallurgy. The family has achieved a conspicuously honorable position in the profession. Edgar Collins first made his mark as superintendent of the Combination mine at Goldfield, Nevada, and later as superintendent of the Commonwealth mine, at Pearce, Arizona. Last year he was appointed resident manager for the Ridder mine of the Russo-Asiatic Corporation in the Altai and had barely assumed his new responsibilities when the Bolshevik revolution compelled the cessation of mining operations and his return to the United States. He arrived well and cheerful, ready to undertake new work, preferably patriotic, which was promptly offered to him by Mr. Burch in behalf of the Bureau of Mines. We record his death with the deepest regret, and we know that it will be shared by all that knew him.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

J. M. Nicol has gone to Honduras.

Charles H. Munro and **R. F. Lewis** have gone to Jarbidge, Nevada.

David T. Day of the U. S. Geological Survey was in San Francisco this week.

D. C. Jackling spent the end of last week at Salt Lake City, on his way to New York.

A. C. Lawson, professor of geology in the University of California, is at Bingham, Utah.

Algernon Del Mar has become manager of the Techatticup mines, El Dorado canyon, Nevada.

R. Itoh and **T. Nabeshima**, of the Mitsubishi Company, are visiting mines and smelters in the West.

Lucien Eaton, of Ishpeming, has been appointed Captain in the Engineer Officers Reserve Corps.

H. C. Wilmot has left New York for Prescott, Arizona, where he expects to be for several months.

R. T. Walker has been appointed superintendent for the Virginia-Louise Mining Co., at Pioche, Nevada.

Robert Dye has succeeded **D. L. Forbes** as manager of the Teck-Hughes at Kirkland Lake, Ontario, Canada.

James L. Bruce and **B. H. Dosenbach**, of the Butte & Superior Mining Co., were at Salt Lake City last week.

H. A. Guess, managing director of the mining department of the A. S. & R. Co., was at Salt Lake City last week.

Edward A. Austin, formerly with the Yukon Gold Co., is superintendent of the Elkoro mine at Jarbidge, Nevada.

F. Le Roi Thurmond has returned to Anchorage, Alaska, from a two months trip examining prospects in Broad Pass.

F. B. Caldwell is working for the U. S. Bureau of Mines, under **Albert Burch** in the investigation of chromite deposits.

Charles A. Randall has been made assistant to Douglas A. Mutch, general manager for the Dome Lake Mining & Milling Company.

D. W. Brunton is chairman of a committee appointed by the War Department to investigate inventions and devices useful in war.

E. P. Mathewson has been appointed consulting metallurgist to the American Smelting & Refining Co. with headquarters at New York.

R. M. Catlin has received the honorary degree of Doctor of Science at the recent commencement of Rutgers College, New Brunswick, New Jersey.

A. E. Wiggin has been appointed superintendent of reduction department for the Boston & Montana, at Great Falls, Montana, succeeding **J. H. Klepinger.**

Forest Rutherford, consulting metallurgist, has been appointed a member of the advisory committee on non-ferrous metals to the U. S. Tariff Commission.

Jerome B. Landfield, formerly employed by the Russian government in the capacity of mining engineer, has gone to Washington to advise on Russian affairs.

W. A. Carlyle has taken over the duties (in addition to his own) formerly assigned to **E. P. Mathewson** with the British America Nickel Corporation, at Sudbury, Canada.

Brent Neville Rickard, metallurgist and assistant superintendent at the Tacoma smelter, of the A. S. & R. Co., passed through San Francisco on his way to Salt Lake City.

J. O. Elton, superintendent of the Anaconda company's electrolytic zinc plant at Great Falls, Montana, is doing special work with the U. S. Bureau of Mines. **R. B. Caples** takes charge of the plant in his absence.

THE METAL MARKET



METAL PRICES

San Francisco, June 4

Aluminum-dust, large and small lots, cents per lb.	65—70
Antimony (wholesale), cents per pound	15
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7¼ — 8¼
Platinum, Government price, per ounce	$105
Quicksilver, per flask of 75 lb.	$110
Spelter, cents per pound	9¼
Zinc-dust, cents per pound	17½

ORE PRICES

June 4

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38% and over, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton (nominal price)	$7.00—$8.00
Manganese, domestic, 35 to 54%, f.o.b. South Chicago, per unit	$0.84—$1.30
Manganese, domestic, 35 to 54%, f.o.b. east of South Chicago, per unit	$0.95—$1.45
(Manganese, domestic, penalty of 50c. to $1 per unit for silica and up to 25%, and bonus of 50c. to $1 for less than 8 and 5%.)	
Molybdenite, per lb., 90% MoS_2	$1.25
Pyrite, domestic, New York, cents per unit of sulphur	28
Tungsten, 60% WO_3, California, per unit	$24

The U. S. Tariff Commission will hold a conference at the Chamber of Commerce, San Francisco, to which all interested are invited. On June 24, at 10 a.m., the antimony situation is to be discussed; on the 26th, quicksilver; and on the 28th, tungsten. A hearing on tungsten will be held at Denver on the 17th at the New Post Office building.

EASTERN METAL MARKET

(By wire from New York)

June 4.—Copper is unchanged. Lead is more active and stronger. Spelter is strong and steady. There is no quotation for platinum.

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67½c. for small lots, effective until June 1, 1918. These prices remain in force until August 15, 1918. Quotations in cents per pound are as under:

Date		Average week ending	
May	29 23.50	Apr.	23 23.50
"	30 Holiday	"	30 23.50
"	31 23.50	May	7 23.50
June	1 23.50	"	14 23.50
"	2 Sunday	"	21 23.50
"	3 23.50	"	28 23.50
"	4 23.50	June	4 23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	23.50	Oct.	28.50	23.50	....
May	29.02	31.69	23.50	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

The advance statement of United States copper production in 1917, by B. S. Butler, has just been issued by the U. S. Geological Survey. The principal figures appear in the New York metal letter on the following page. The domestic consumption was 1,316,463,754 lb., a drop of 113,000,000 lb. Exports totaled 565,000 tons, and imports 278,000 tons.

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to make prompt settlements with smelters and brokers, producers allow a discount from the Government price of $1, hence the lower price. The Government has not fixed the general market price at $1, but will pay this price (as from April 23, 1918) for all silver purchased by it. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the current rate of exchange.

Date	New York, cents	London, pence	Average week ending	New York, cents	London, pence
May 29	99.50	48.87	Apr. 23	97.35	
" 30 Holiday			" 30	99.06	
" 31	99.50	48.87	May 7	99.52	
June 1	99.50	48.87	" 14	99.50	
" 2 Sunday			" 21	99.50	
" 3	99.50	48.87	" 28	99.50	
" 4	99.50	48.87	June 1	99.50	

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	60.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	58.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	57.86	87.38	....
May	74.27	74.61	99.50	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. On May 25, 1918, the Government fixed prices until September for grade A spelter at 12c. per lb. for itself and the open market. This grade constitutes only a small proportion of the total output. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c., and plate at 14c. per pound.

Date		Average week ending	
May	29 7.50	Apr.	23 7.00
"	30 Holiday	"	30 6.88
"	31 7.50	May	7 7.00
June	1 7.50	"	14 7.21
"	2 Sunday	"	21 7.41
"	3 7.50	"	28 7.50
"	4 7.50	June	4 7.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.08	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	7.29	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Second-grade zinc ore at Joplin, Missouri, was up $1.50 per ton last week, the range being $42.50 to $47.50.

The Dominion government at Ottawa has ordered the payment of a bounty of 2c. per pound on zinc. This will benefit British Columbian producers considerably.

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date		Average week ending	
May	29 7.10	Apr.	23 6.95
"	30 Holiday	"	30 6.83
"	31 7.15	May	7 6.72
June	1 7.15	"	14 6.73
"	2 Sunday	"	21 6.92
"	3 7.20	"	28 7.07
"	4 7.20	June	4 7.16

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	6.88	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

Lead ore at Joplin, Missouri, last week rose from $84 to $85 per ton, basis 80% metal.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date			
May	7 110.00	May	21 110.00
"	14 110.00	"	28 110.00
		June	4 110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	...
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115.00	Oct.	78.20	102.00	....
May	90.00	104.00	110.00	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	100.01	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Spot Banca tin is quoted at 99c. on the Pacific Coast, and No. 1 Chinese at 90 cents.

The Llallagua tin smelter, operating at Arica, Chile, is working on a small scale. Up to April, 30 tons of 99.8% metal had been produced. The plant comprises one reverberatory, one liquating, and one roasting-furnace, with a monthly capacity of 1000 tons of barilla (concentrate), producing approximately 650 tons of metal. California petroleum residuum is used for fuel. An additional reverberatory and a roasting-furnace are under construction, which will increase the capacity of the plant to 1500 tons of barilla in about two months, at which time the present Llallagua contract will have expired.

ORES

Antimony: There is no activity, and the market is unchanged at nominal quotations reported recently.

Molybdenite: The market is inactive and nominal at $1.25 per lb. of MoS_2 in 90% concentrate.

Tungsten: Quotations are unchanged at $20 to $24 per unit in 60% concentrate, with only moderate activity. Material containing impurities, but as high as 65% WO_3, has sold at $24 per unit. Ferro-tungsten is nominal at $2.25 to $2.35 per lb. of contained tungsten.

Eastern Metal Market

New York, May 29.

There has been little change in the markets during the past week. They have been only moderately active and price-changes have been insignificant except in tin. The market is firm, however, in nearly all metals.

Copper prices are to remain unchanged officially until August 15.

Tin is being offered a little more freely, and prices are lower.

Lead is fairly active and firmer.

Zinc is quiet, but firm and steady.

Antimony is lower and dull.

In the steel world, the industry is distinctly on a war-basis with almost the entire output subject to Government call. There is, however, a decided rejection of reports of Government preparations to lay hold of the machinery of steel production. There are new Government operations projected on a large scale—two more shipyards and perhaps additional gun plants. Preference is given now absolutely to plates for ships, shell-steel coming second. The advance in freight rates, just announced, will bear heavily on pig-iron and costs of steel, says 'The Iron Age.' With close to five tons of raw material and supplies represented in a ton of steel, the new freight schedule means $2 to $3 additional per ton of finished material. About 20,000 tons of shipbuilding material for Japan, in storage on the Pacific Coast, has now been shipped, but licenses have not yet been issued, though expected daily, on the remaining 155,000 tons of the unused tonnage to go in compensation for Japan-built ships.

COPPER

The suspense is over and the market can now settle down to the regular controlled routine which has characterized it for so long, that is, to a Government regulated industry with no market nor speculative features. The relief is due to the fact that the question of a revision of copper prices has been answered by the announcement that the War Industries Board has decided that the present price of 23.50c. per pound for carload and 24.67½c. for less than carloads shall prevail unchanged until August 15. The fact that only 75 days is fixed as the time for a continuance of present levels is regarded by some as a hint or a hope that a revision upward may come then. At least this has been a factor in relieving the disappointment which is and has been keen among many because at least a small advance was confidently expected. The advance statement of the U. S. Geological Survey as to last year's copper production is published. It shows to what extent strikes affected the output last summer. The production of smelters in 1917 was less than in 1916 by over 41,000,000 lb., that of last year having been 1,886,120,721 lb. as compared with 1,927,850,548 lb. in 1916. Refined copper output in 1917 was larger than in 1916 by about 143,000,000 lb. or 2,507,663,067 lb., against 2,363,811,122 lb. in 1916, due to an increased output of electrolytic from foreign copper. Stocks on hand January 1, 1918, were 14,000,000 lb. Both exports and imports made records in 1917, but the apparent consumption in 1917 was less than in 1916 by over 100,000,000 pounds.

TIN

The tin situation has decidedly reversed itself as compared with a short time ago. There were then more buyers than sellers; now there are more sellers than buyers. No longer than about ten days ago future shipments from the Far East brought 97c. per lb. Today they are down to 88c., and perhaps slightly lower. This is a decline of about 10c. per lb. The market continues quiet, with more metal being offered. Sellers are increasing in number, due to the Banca situation. It is the belief that more metal will soon be available from Batavia, Java, though the actual situation there is clouded. There are reports that ships have sailed, or are about to sail, while in some quarters this is denied. The entire Banca situation is in doubt, but the belief in an easier condition there is stronger, and the market is therefore sagging. Buyers, however, are careful, and are disinclined to act to any extent, so that the business actually done in the last week has been but little. Arrivals at Atlantic ports up to May 27, inclusive, have been 1145 tons. Arrivals at Pacific ports on May 21, 22, and 27 totaled 810 tons. The London market is also lower, with spot Straits quoted at £355 per ton yesterday, or £8 lower than a week ago.

LEAD

The market is daily growing stronger, and inquiry is decidedly more general. One large dealer reports inquiries much more active in the last week than in a month. Sales have also been fairly good. The market is firm and steady at 6.85 to 6.90c., St. Louis, or 7.10c., New York, with that of the American Smelting & Refining Co. unchanged at 7c., New York. Spot lead is held at about 7.25c., New York. The only feature of the market is the fact that prompt lead is difficult to get, which has been a prevailing characteristic for two or three weeks.

ZINC

It is officially announced that there will be no change in the Government price of 12c. per lb. for grade A zinc after June 1. It is to continue for about 90 days. The prices of 15c. for sheet zinc and 14c. per lb. for plate zinc are also to remain fixed for the same period. The other grades of zinc are left unregulated as heretofore. Prime Western for early delivery is not active, but is firm at 7.25c., St. Louis, and 7.50c., New York, though this has been shaded to 7.20c., St. Louis, in one or two cases. There is very little doing in general, but optimism prevails largely among producers. It is reported that one Western representative of some producers has recently sold July-August-September delivery at 7.30c., St. Louis, but the general quotation is fairly firm at 7.32c., St. Louis, for third quarter.

ANTIMONY

The market is a little lower at 12.25 to 12.50c., New York, duty paid, because of a gradually easier tendency since the fairly large Government buying recently.

ALUMINUM

Both No. 1 virgin metal, 98 to 99% pure, and scrap aluminum, are held at the Government price of 32c. per lb. for 50-ton lots, 32.10c. for 15 to 50 tons and 32.20c. for 1 to 15 tons.

FERRO-MANGANESE

The market is active and fairly large sales are reported at $250, delivered, for 70% alloy, with $4 per unit above this standard. The new standard is being generally accepted. Spiegeleisen is also active, but scarcer than ferromanganese. Large sales have been made of small lots and lots up to 1000 to 6000 tons at $70, furnace, for 16 to 18% alloy, with $3.50 per unit above the 16% standard which is also becoming general. Alloy of 30 to 40% manganese content has sold at $3.90 per unit.

Company Reports

ALASKA GOLD MINES CO.

Alaska Gastineau Mining Co.

Property: large gold mine, mill, and power-plants near Juneau, Alaska.

Operating Officials: B. L. Thane, manager; G. T. Jackson, assistant; D. J. Argall, superintendent of mines; E. V. Daveler, superintendent of mills.

Financial Statement: Alaska Gold now holds $11,756,100 par value of Alaska Gastineau's $12,000,000 stock, and $3,269,000 of its $3,500,000 bonds.

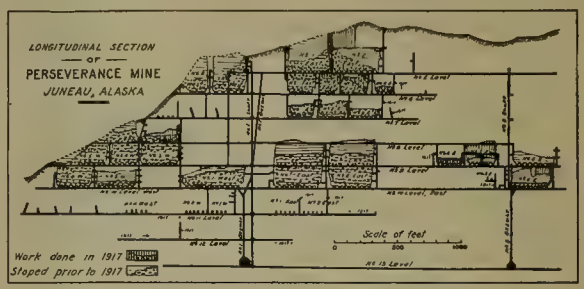
A comparison of the past two years shows the following:

	1917	1916
Revenue from gold	$2,009,632	$1,837,291
Sundry income	12,071	37,198
Total receipts	$2,021,703	$1,874,489
Operating charges	1,724,474	1,543,908
Extraordinary expenses	26,403	.....
Total expenditure	$1,750,877	$1,543,908
Operating profit	270,826	330,581
Interest paid	228,552	217,747
Net income	$42,274	$112,834

By decreasing the deferred charges account by $210,853, adding this to the profit for 1917, interest was paid on debentures and notes payable. The latter were reduced from $650,000 to $500,000. Current assets were $896,-082 at the end of 1917, a decrease of $44,946, while deferred charges to operations decreased $210,853 to $535,-403. Current liabilities are $763,640, a drop of $154,858. Reserves for depreciation, etc., remain at $325,045.

Development: normal operations were hindered by the general labor situation, but broken ore in stopes supplied the deficiency caused thereby. There were only 712 men employed, against 940 in 1916.

Development and prospecting for orebodies was prosecuted as energetically as conditions would permit. A total of 15,472 ft. of drifts, cross-cuts, and raises, and 12,754 ft. of diamond-drilling was completed. The principal object of this work was to find new and richer orebodies in order to maintain the average grade of the ore sent to the mill, and, if possible, to increase the average value. This work was conducted principally in the block of ground between No. 1 and 2 shafts on No. 6, 7, 8, 9, 10, and 13 levels. Its object was the further development of the schist ore-zone which had originally shown good areas and satisfactory value on No. 5 and 10 levels, from which a large tonnage of good ore had been milled; also to further prospect the ore-zone east of No. 2 shaft on its strike toward Sheep creek, and to develop the block of ground between No. 10 and 13 levels west of No. 1 shaft, and finally to do some prospecting on No. 2 vein west of the Alexander cross-cut. The net result of the year's work has shown no new bodies of any consequence east of No. 2 shaft, and has confirmed the work of 1916 relative to the schist body, namely, that its largest areas and best ore were found on No. 10 and 5 levels, diminishing between these two levels in both size and value. An effort was made to find the same schist body in its trend on No. 13 level, without success. Such of this ore as was developed on No. 6, 7, 8, 9, and 10 levels, although of limited quantity, was of much better grade than the average slate ore west of the shaft. Below and in the ground tributary to No. 2 shaft, which extends only to No. 10 level, the principal work done was on No. 11 level with some on No. 12; and although this is still unfinished, indications are that the ore-zone in this block will have a value approximating that milled during the past two years. No commercial ore was found in development on No. 2 vein west of the Alexander cross-cut, although a cross-cut between No. 1 and 2 veins in the west end of the property indicated possible orebodies to be prospected in the future. Considering only the block of ore between No. 1 and 2 shafts, and from No. 5 and 13 levels, and estimating the value on results obtained from past operations, there would appear to be available for milling in this block some 9,000,000 tons of ore worth approximately $1.06 per ton. Of this amount 2,357,588 tons is already broken, 2,398,242 tons is prepared for stoping but not broken, and 4,799,487 tons prospected but not prepared. Further prospecting



and development work will be necessary before the exact value and tonnage of this block can be accurately estimated, and the value of the ore sent to the mill from month to month, or year to year, will be dependent upon mining conditions and may or may not approximate the average of the total orebody, depending upon the proportions of ore drawn from different sections of the mine. No change to advantage has been indicated in the system of mining originally adopted, and thereafter up to the present employed.

Production: the past two years compare as under:

	1917	1916
Ore milled, tons	2,240,346	1,892,788
Average per ton	$1.103	$1.193
Tailing, per ton	0.206	0.222
Extraction, per cent	81.32	81.33
Costs, per ton:		
Mining	$0.42285	$0.38412
Milling	0.26026	0.26881
Shipping and smelting concentrate	0.03522	0.03297
General	0.05141	0.12978
Total	$0.76974	$0.81568

So far as costs are concerned, D. C. Jackling says that operations have proved that the original estimates were more than ample.

GOLDFIELD CONSOLIDATED MINES CO.

Property: gold mines and 100-stamp mill and treatment plant at Goldfield, Nevada.

Operating Officials: J. W. Hutchinson, general manager; J. B. Kendall, mine superintendent; Earle W. Hart, mill superintendent; R. H. McLoughlin, chief engineer; H. N. Witt, geologist; B. B. Beckett, electrical engineer; E. M. Moore, purchasing agent; R. J. Davey, cashier; and E. A. Julian, engineer in charge of exploration department. J. W. Hutchinson and J. B. Kendall recently resigned.

Financial Statement: during 1917 sales of bullion realized $1,439,716, plus $290,454 for sales of sundry mill products and $26,765 for other earnings. Deducting $85,649 paid for ore purchased and lessees, the total was $1,671,285. Operating expenses amounted to $1,493,519, less $68,134 for exploration charges. Adding interest, etc., the net profit was $128,501. Balance at start and end of year remained at $1,183,763. As the property has no great future, assets

were valued, giving a total of $2,331,000. Six years will be required to realize this amount. On the 3,559,148 shares issued this is equal to 65½c. per share.

Dividends: none were paid in 1917, so the total remains at $28,999,832, or $8.15 per share.

Development: in August last the ore exposed underground became unprofitable. Ore-reserves and dumps at all the company's mines on Jan. 1, 1918, contained a total of 125,000 tons. At least double that quantity is expected to be milled before operations cease.

There are now 40 sets of lessees at work, employing 80 men, in certain sections of the Clermont, Grizzly Bear, Combination, Mohawk, Red Top, and Laguna mines. Last year they mined 14,770 tons of ore assaying $14.75 per ton. Their net return from the company was $82,237, out of which they paid for labor and explosives. All underground work cost $2.78 per ton.

The Exploration Department investigated 696 properties, and examined 45. Option on the Lampa mine in Peru was given up. In February 1917 an option was taken on Montana Mines Co.'s property in Santa Cruz county, Arizona. Ore developed amounted to 30,000 tons, assaying 12% zinc, 6% lead, and 6 oz. silver per ton. Exploration at depth shows that the vein weakens. The mine is not to be purchased. A concentrating mill is in operation. The Ash Peak mine in Greenlee county, Arizona, was also taken under option. A silver-bearing quartz vein of unusual persistence was opened to depth of 500 ft., and is increasing in value with depth. In Butte county, California, the Surcease gold mine is being opened under option. A shallow adit shows 5 ft. of $12 ore over a length of 100 ft. Deeper work is in progress. Some claims near Hazleton, British Columbia, are being prospected.

Production: the mill treated 250,550 tons of ore averaging $8.14 per ton, also 81,885 tons of old tailing assaying $1.27 per ton. Of the ore, 66% was treated by cyanidation and 33% by flotation. It was found advisable to sell concentrate from the flotation plant. Reserves of tailing are estimated at 1,800,000 tons, averaging $1.50 per ton. From this should be extracted $1, less 60c. cost, making total profit of $720,000. Production to date is 3,094,353 tons of ore assaying $23.40 per ton gross, equal to $72,393,065. The mill has treated 2,874,622 tons, yielding $51,200,817.

Costs: during 1917 these totaled $6.32 per ton; $2.78 being for mining, $2.41 for treatment, 44c. for general, and 36c. for marketing. The average cost for 9 years is $6.81 per ton. Increase of 1917 over 1916 was 83c. per ton.

VINDICATOR CONSOLIDATED GOLD MINING CO.

Property: gold mines and works at Cripple Creek, Colorado.

Operating Officials: W. E. Ryan, general superintendent; Louis S. Noble, consulting engineer.

Financial Statement: ore sales and royalties ($153,683) from lessees totaled $896,621 in 1917, plus $17,503 from sundries. Operations cost $717,775, leaving a profit of $196,348.

Dividends: four quarterlies absorbed $180,000, equal to 12%. This makes $3,712,500 to the end of 1917.

Development: new openings amounted to 10,327 ft., lessees doing 5515 ft. The total to date is 255,434 ft. Exploration did not reveal material additions to ore-reserves, which are estimated as 255,500 tons. In a caved area adjacent to the Golden Cycle shaft there is a large tonnage available. On No. 20 level of this shaft and No. 19 of the Vindicator there was nothing new developed.

Production: 39,799 tons of company ore valued at $973,537, and 47,119 tons of lessees' ore worth $716,804. Freight and treatment on these cost $480,156. To produce the 39,799 tons there was mined 205,691 tons. Crude ore is sized, washed, and sorted into shipping ore, that suitable for the flotation plant, and waste. Cost of flotation is higher than expected, but results are satisfactory.

BEAVER CONSOLIDATED MINES, LTD.

Property: silver mine and mill at Cobalt, also gold mine at Kirkland Lake, Ontario.

Financial Statement: during the year ended February 28, 1918, ore and bullion sales, etc., realized $354,341. Operations cost $247,044. Cash on hand at March 1, 1917, was $151,890, against $15,701 a year later. Kirkland Lake Gold Mining Co.'s shares purchased cost $310,242. Profit and loss balance at credit amounts to $744,276.

Development: at Cobalt 4952 ft. of new work was done, including 75 ft. of sinking a winze below 1600 ft. A new orebody was opened on the 530, 600, and 700-ft. levels. To a depth of 67 ft. below the 1600-ft. level below the diabase sill in Keewatin formation mill ore has been opened, also to 147 ft. above the level.

At Kirkland Lake, 4590 ft. of work was performed. No. 2 shaft was sunk to 700 ft. A new main shaft is being sunk. Good ore was found on all levels save No. 2. Reserves are estimated as worth $700,000. A 150-ton mill is under erection, while a hoist, compressor, and power-plant were completed.

Production: the plant worked 310 days, extracting 372,973 oz. of silver.

HEDLEY GOLD MINING CO.

Property: the Nickel Plate and Sunnyside mines, 40-stamp mill, cyanide works, and 1800-hp. hydro-electric power-plant at Hedley, British Columbia.

Operating Official: Gomer P. Jones, general superintendent.

Financial Statement: the net profit in 1917 was $238,095, out of $737,840 received for gold extracted. Surplus on January 1, 1917, was $443,688, and that of a year later $441,783.

Dividends: four absorbed $240,000.

Development: 1030 ft. of new openings were made, also 3766 ft. of diamond-drilling. The Dickson incline is down 970 ft. All stopes from No. 3 to the 900-ft. level, about 1400 ft. of stoping ground, are of normal grade. Drilling indicates better ore at 900 ft. Reserves consist of 313,000 tons of $10.01, and 87,650 tons of $6 ore.

Production: the works treated 71,207 tons of $11.29 ore, at a cost, including all expenditures, of about $7 per ton.

The cheap power derived from the hydro-electric works will enable operations to continue, in spite of taxes and other charges.

CERRO de PASCO COPPER CORPORATION

Property: all of the mining properties and other assets of the Cerro de Pasco Mining Co., and Morococha Mining Co., which companies were dissolved in 1917. The corporation also controls the Cerro de Pasco Railway Company.

Financial Statement: in 1917, sales of metals and ore realized $24,974,082, inventory $3,927,955, dividends $1,091,764, and sundry revenue $188,715, a total of $30,182,515. Operations cost $7,832,006, custom ores $5,342,394, taxes $1,207,822, reserve funds $7,039,175, and inventory $3,147,520. The profit was $5,613,598. The balance on Jan. 1, 1917, was $187,552, and a year later $11,447,916, the surplus from subsidiaries being included.

Earnings of the railway were $1,043,090, of which $350,519 was profit. Balances were $1,281,156 at beginning of the year and $1,147,175 at the end. One dividend absorbed $484,500.

Dividends: four, each with an extra, totaled $4,009,471.

During 1917 the mine and smelter operated satisfactorily.



INFORMATION FURNISHED BY MANUFACTURERS

TRAINED EMPLOYMENT MANAGERS

The first course of intensive training in employment management under supervision of the Government opened at the University of Rochester on March 26. Twenty prospective employment managers, sent by manufacturers having war contracts, including shipbuilding plants and several departments at Washington, began to take a six weeks' intensive training in practice and theory of employment management. Fifteen Rochester factories are providing the laboratory work and assisting the University of Rochester in presenting the theory of personnel management. The course is given at the express request and under the supervision of the Industrial Service Sections of the several departments at Washington, including the Emergency Fleet Corporation, the Ordnance Department, the Quartermasters Department, the Department of Labor, and the Navy. The work has the endorsement of the Educational Committee of the General Staff of the War Department and the War Industries Board. The Storage Committee of the latter has undertaken the organization of the work.

The establishment of this course, which will be repeated later in Boston, New York, and elsewhere, gives official recognition to the function of personnel management in factory administration. Hitherto, executive control has been exercised through three main divisions of management: (1) finance, usually in charge of the treasurer; (2) manufacturing, sometimes in charge of a general manager; and (3) sales, in charge of a sales manager.

To these general divisions of every industrial enterprise is now added a fourth, namely, personnel, or, as it is called in these courses, employment or service management. Under the head of employment or service departments are gathered all activities that have to do with human relations, such as legislation, safety, education, recreation, 'hiring and firing,' discipline, the wage-system, pensions, and sick benefits. Bringing these matters together under one head and manning each sub-section with specialists comes near to scientific industrialism.

Within the last three years manufacturers voluntarily initiated employment departments in so many cases that an association of employment managers sprang up in Boston, Detroit, Philadelphia, Chicago, Cleveland, and other cities. So far, there is said to be no case on record where a separate employment and service department once installed has been discarded, and the tendency has been progressively to take out of the hands of superintendents and foremen such authority over personnel management as they have been exercising, and to place it in the hands of a separate department, adding to it new functions for which formerly no one on the executive staff had time or training to exercise.

The War has given a great impetus to this new development. France and England early discovered the importance of devoting special study to the psychology and physiology of workers in war plants, and to the assignment of specialists to care for the mental and physical needs of workers and to assure them just treatment. The British Munitions Ministry, after thorough study, has demonstrated to manufacturers the inefficiency resulting from overwork and inadequate facilities for the workers. The department corresponding to our Ordnance Department in France has instituted intensive training of welfare workers, particularly for plants having many women employees. In this country, industrial service sections were formed in various war conducting departments to assist manufacturers and workers in the solution of the special labor problems rendered acute by the War. These departments have been hindered by two things. In this country there were large numbers of workers for whom no one was directly authorized to speak, and misunderstandings and strikes have grown out of this. On the other hand, whereas the War required the Government to guide manufacturers in labor questions along lines often wholly new, and required the participation in labor matters by procurement divisions of the Government, in more than 90% of the cases there was no executive in our factories assigned to dealing with workers exclusively and able to give effect to the Government's labor policies.

A representative of the Industrial Service Section of the Ordnance Department has declared that no labor difficulty has been brought to the attention of that Department that could not have been foreseen and avoided if the factory in question had already established a modern employment department. A notable instance came to the attention of the Quartermasters' Department where two mills, side by side, working on the same type of material on Government contracts and employing the same type of workers, got totally different results from those workers, because one had a well-conducted employment and service department and the other had not. The former even paid a slightly lower wage, but the one which had no employment department had repeated difficulties, leading to a total shut-down from a strike, and even though it yielded every demand made by the strikers, including a 15% increase in wages, a shorter work-day, the abolition of bonus, and the recognition of a shop-committee, it could not fully allay the difficulties. Meanwhile, the mill next door kept peacefully on, producing goods every day. This was due to the fact that justifiable complaints of workers were discovered and attended to, as they arose, by the employment department.

The Government has already seen the benefit which may come from short-time intensive training. Not alone have factory employees rapidly gained proficiency in many tasks when given special instruction, as, for instance, women workers on lathe and other skilled operations, but various types of special training in army work have also been imparted in an astonishingly short time. Officers for the Army have been trained in three months, with fair results. The Ordnance Department has established six-weeks courses in store-keeping, and these training schools in warehousing now dot the country at the various universities. The Red Cross conducts intensive courses for its various types of work. In France the Government has successfully conducted courses for supervision of employment. Liberal hopes, therefore, are entertained for the first course for employment managers at Rochester and for the further development of the movement at other universities. The

courses, besides the laboratory work in factories, will include theoretical instruction in employment-department practice, labor economics, industrial organization and management, and the theory of statistics. No one will be admitted to the courses who may have just completed his college course and who has a meagre industrial experience. The aim is to have manufacturers of war-contract plants select men who might succeed as employment managers even without training, and send them to the courses on their own responsibility. Men of enthusiasm, varied industrial experience, good education, liberal point of view, and the reserve and balance which must accompany the power to command men, should be chosen for this work, and they should be given good salaries and ample authority when they have been properly settled in their work.

It is desired that the manufacturers take a hand in the development of this movement and send students on their own initiative. Any member of the National Chamber of Commerce that wishes to send a student to one of these courses should write to Employment Managers' Division, 5207 New Interior Bdg., Washington, D. C., which is handling the detail-work for the various departments. The next course will be opened at Boston with Harvard University, the Massachusetts Institute of Technology, and the Boston University co-operating in the instruction, and the Boston Employment Managers' Association directing the laboratory work. The chairman of the Committee on Industrial Relations is Henry P. Kendall.

THE WORTHINGTON COMPANIES

The election of Charles Philip Coleman as president of the Worthington Pump & Machinery Corporation calls attention to this large industrial enterprise and to the new executive, who has had an experience that exceptionally fits him for the position. Mr. Coleman advances from the post of vice-president, held since May 1916. He was, prior to that date, receiver of the International Steam Pump Co. and associate companies, which have now been re-organized into the present corporation, which owns and controls some of the best equipped works in the country, and is the leading concern in the world making pumping machinery. Mr. Coleman was born at Baltimore. His education was begun at Baltimore and continued at the Virginia Military Institute and the Shenandoah Valley Academy at Winchester. Later he graduated from Lehigh University, with the degree of M.E. He entered the employ of the Lehigh Valley Railroad Co. and continued with that company in the various positions of car agent, chemist, engineer of tests, assistant to general superintendent, and general storekeeper, until 1903, having left the Lehigh for two years during this time to serve the Bethlehem Steel Co. as purchasing agent and assistant to the president. Later he was made general purchasing agent of the Lehigh Valley railroad, with headquarters in New York. The Singer Sewing Machine Co. made Mr. Coleman its secretary and treasurer in 1903, and he had charge of the construction of the Singer building, at that time a most unusual undertaking. After leaving the Singer company he became president of the Saurer Motor Co., and afterward of the International Motor Co. He came to the International Steam Pump Co. in 1913 as vice-president, and upon the outbreak of the War in 1914 was made one of the co-receivers of the company, which had been compelled to go into the Federal Courts because of financial difficulties. Mr. Coleman became sole receiver in 1915, and handled its affairs until its re-organization in 1916, obtaining the warm commendation of the United States Court.

The Worthington Pump & Machinery Corporation, of which Mr. Coleman has just become president, is active in its service to the Government. With its eight large works in this country and a European plant, it is in an unusually good position to serve both the United States and its Allies. While the principal business of the corporation is pumping machinery, it turns out other standard products, including mining and concentrating machinery, oil and gas engines, air-compressors, gas-power engines and blowers, crushing and cement equipment, water-works engines, and special machinery. The plants now operated in the United States



C. P. COLEMAN, PRESIDENT OF THE WORTHINGTON CORPORATION

by the corporation are: (1) the great Worthington works at Harrison, N. J., the largest plant in the world devoted exclusively to the manufacture of pumping machinery; (2) the Blake & Knowles works at East Cambridge, Mass., producing principally marine pumps; (3) the Deane works at Holyoke, Mass., which manufactures power-pumps only; (4) the Snow-Holly works at Buffalo, N. Y., building the largest machines required in water works, blowing and gas-power engines, and oil engines; (5) the Power & Mining Machinery works at Cudahy, Wis., which makes a complete line of crushing, concentrating, and mining equipment; (6) the Laidlaw works at Cincinnati, Ohio, devoted to air-compressing machinery only; (7) the Jeanesville works at Hazleton, Pa.; and (8) the International Gas Engine works at Cudahy, Wisconsin.

'The Proper Care of Belts' is the title of a new booklet by the Joseph Dixon Crucible Co., now available for anyone desiring a copy. As long as the life and pliability of a belt is preserved it is worth its cost price. To neglect belts will result in a two-fold loss: a waste of power due to the inefficiency of the belts, and increased cost due to frequent renewals. Now as never before it is essential that belting be given careful attention. The booklet contains helpful suggestions for getting maximum results from belts, and in addition has several pages devoted to useful information of a general character.

The Aetna Explosives Co., Inc., of New York has issued a booklet on 'Blasting Caps and Electric Blasting Caps' for general distribution that gives a large amount of valuable information on the construction of caps, charges used, method of storage and handling, and the efficiency of various grades for specific purposes.

H. D. Wright, manager of the San Francisco office of the Brown Hoisting Machinery Co. of Cleveland, has been appointed Pacific Coast representative of that company in the North-West territory, succeeding the Colby Engineering Co. His office is in the Monadnock building, San Francisco.

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EDITORIAL

CANTIGNY is followed by Château Thierry. Our boys at the front are doing as the Allies hoped and as we expected. The stars in Old Glory are shining as never before!

ONE hundred scholarships are to be established in American colleges for French women. The gift has been accepted by the universities of France. We hope that the ladies will remain here after they finish their post-graduate courses and marry our sons, for they represent a stock that will enrich the racial heritage of America. The mothers of France have proved themselves of heroic mould and it is from them that their sons have drawn inspiration in the crisis of their fate.

THE new schedule of prices for domestic manganese ore will be found summarized on our Metal Page this week. This was arranged by the American Iron & Steel Institute, and was approved by the War Industries Board, taking effect after May 28. Briefly, from 86 cents to $1.30 per unit will be paid for ore containing from 35 to 54% metallic manganese, with premiums and penalties for silica under and over 8%. The prices are somewhat higher than those prevailing during the past few months.

CONSOLIDATION of the express companies with a view to more economical administration is a good thing. Now that they are to operate under Government control, they will, let us hope, show a better code of conduct, even at the cost of more red tape. The unprincipled manner in which charges have been collected at both ends, especially on presents, is a blot on the records of these common carriers and it is one that the citizen is warranted in resenting bitterly, as we do, having been victimized on several occasions.

SHIPPING facilities are utterly inadequate for transporting materials from the West, and no remedy seems to be possible at this time. In our last issue Mr. E. H. Wedekind suggested that California pyrite might be sent to the Atlantic seaboard as ballast, but the U. S. Shipping Board informs us that orders from Washington require the loading of all vessels with grain and other food-stuffs that are sufficiently heavy to obviate the necessity of using ballast. The only exception relates to ships that are occasionally dispatched to Chile for cargoes of nitrate. These sometimes go partly laden, despite the demand for lumber and manufactured articles in that country. The need of nitrate is so urgent that the Government is not willing to allow time for the loading and unloading of other cargo. The ships take on the nitrate at Chilean ports for Atlantic coast points and do not return. Practically no vessels come from the East at the present time. California could supply large quantities of pyrite and alum, if means of transportation were available.

PESOS are not being issued by the Mexican mint, and practically none are in circulation. All the silver now being coined in that country is made into fractional currency, on which a larger profit accrues to the Treasury because of its lower fineness. All the local mints have been closed, and coinage is done at Mexico City only. The result is that no favorable markets exist for the output from the smaller mines. The cost of transporting bullion to Mexico City, for example, from the West Coast, is so great as to be practically prohibitive, and no insurance can be obtained. The result is to force the producers either to ship to the United States at considerable cost and inconvenience, or to sell at a heavy discount from the market value to commercial houses, most of which are controlled by Germans.

GOLD production of Australia continues to decline. Figures to hand for the first quarter of 1918 show a total of 319,518 ounces, against 364,613 ounces in the same period of last year. Two well-known producers were shut-down recently, namely, the Great Fingall in Western Australia, which has yielded gold worth $24,000,000 from 2,000,000 tons of ore since 1892, and paid $5,900,000 in dividends; and the Scottish Gympie in Queensland, which, for some time past has been trying to make ends meet by treating $4 ore. This company has paid $3,000,000 in dividends. The principal factor against profitable gold mining in the Commonwealth is the abnormal expenditure on supplies, the cost of which has risen more rapidly in Australia than in other parts of the world.

ADVERTISEMENTS in the local press, by the United States Platinum Company, through a Boston brokerage firm, offer stock in an enterprise formed to exploit a platinum deposit in the Grand Canyon of Arizona. This

deposit is said to be "the only commercial" one in the country and is stated to contain "millions of tons in sight." We have read the prospectus and made enquiries, all of which prompt us to caution the public. The name of Mr. J. M. Boutwell, formerly of the U. S. Geological Survey, is used to substantiate sundry optimistic assertions, and samples taken by him are quoted, showing as much as 2.4 ounces of platinum per ton. Mr. Boutwell's report is not given. We shall be glad to hear from him in confirmation, or in correction, of the statements imputed to him. The prospectus states that there are "millions and millions of tons actually in sight" that "greatly exceed the lowest average sample ($33.91 per ton)." We regret to see an honorable name attached to a scheme apparently so questionable.

OPERATORS of mines in Utah have taken steps to protest against the increase in railroad freight-rates, amounting to 25%. A telegram has been sent to Mr. McAdoo, Director-General of Railroads, explaining that such an increase in the cost of transport will hinder the production of the low-grade fluxing ores needed for smelting and cause the shutting-down of many mines. From Colorado likewise we hear that this increased burden to be placed upon the mining industry is viewed with consternation in a region where so much of the output goes to the smelters and therefore is dependent largely upon low freight-rates. At this time when the waging of a great war calls for an intensive production of metals and minerals, it is a blunder, we suggest, to do anything likely to diminish the necessary supply. This is no time to make a good showing for the railroad administration at the expense of an essential industry.

AWARD of the principal prize given by the School of Journalism in Columbia University has fallen to the New York 'Times' "for the most disinterested and meritorious public service rendered by any American newspaper during the year, in having published so many official reports, documents, and speeches by European statesmen relating to the progress and conduct of the War." This award, and the terms of it, will gratify many of our readers, fully aware of the splendid work that 'The Times' has done in behalf of the national cause. It sheds lustre on the school endowed by Pulitzer, who, like many others, left a large sum of money at his death to undo some of the harm that he had done during his life, for Pulitzer, with 'The World,' started the streak of yellow journalism that Hearst has widened and extended across this continent. This type of journalism is shamed daily by a paper like 'The Times,' which we regard as the greatest newspaper in the language, superior to its namesake in London, now degraded by the unscrupulous commercialism and blatant egotism of Lord Northcliffe, formerly Alfred Harmsworth.

GREAT BRITAIN, by its Board of Trade, has entered into a contract with Australia, represented by the Zinc Producers Association, whereby the whole output of Australian zinc concentrate is to be bought by the British government for the period of the War and ten years afterward. The entire stock of zinc concentrate existing at the end of last year has been taken over. The contract specifies that a maximum of 250,000 tons per annum is to be purchased during the War and for one year thereafter, whereas 300,000 tons is to be the maximum annual purchase for the subsequent nine years. This zinc concentrate comes almost wholly from the Broken Hill district. Before the War, Great Britain consumed 200,000 tons of zinc and smelted only 55,000 tons. Broken Hill was producing a quantity of zinc just equal to the British consumption, yet the bulk of the shipments of concentrate coming from Australia passed up the English channel to Rotterdam, Antwerp, and Hamburg, to be smelted in Belgium or Rhenish Prussia, mostly on German account. The establishment of a British domestic control of Australian production is a result that will profoundly affect Germany's economic status after the War.

NO more pathetically untruthful head-line has appeared in our local organs of misinformation than the one that was flaunted in one of Hearst's papers a few days ago. 'Russia Mobilizes,' it said. We happen to have seen, and talked with, half a dozen mining engineers recently returning from Russia and Siberia. They unite in saying that the Russians have "quit," they are "all in," they are just "lying down," utterly sick, disgusted, and weary of the fighting, for which they have been so poorly prepared and so badly organized. If ever a great people went to pieces and lay down its arms in abject surrender, it is the supposedly new democracy of Eastern Europe. At present it is as much like a democracy as a mob is like an army. Russia is showing how badly the forms of representative government are suited to a people 80% of which is uneducated; it is also showing the contrast between the highly organized military rule of the Prussian and the chaos of complete anarchy. We must be patient with the Russians—yes—but we must not delude ourselves into the belief that any help can come from that quarter in the completion of the great task the Allies have in hand. Russia is waving not only the red, but the white flag also. It will be fortunate if the War ends before the Germans can utilize the resources that they now control in Russia.

SMELTING operations at the Grand Forks plant of the Granby Consolidated Smelting, Mining & Power Company are described admirably by Mr. Walter B. Bishop in a short article in this issue. Mr. Bishop is superintendent of the plant he describes. We are grateful to him for writing an article so much to the point and so carefully prepared. Our readers are aware of the fact that the Granby Consolidated is an American enterprise that can claim to be operating the biggest copper mine in the British empire. The mine at Phoenix and the smelter at Grand Forks, both in the Boundary region of British Columbia, have become relatively old and decadent—as an industry, not technically—but this company is now operating the Hidden Creek mine and

smelter near Anyox, upon Observatory inlet, on the coast of British Columbia, close to the Alaskan boundary, 600 miles north of Vancouver. The Hidden Creek property was acquired six years ago; last year it produced 760,705 tons, the total output of the Granby company in 1917 having been 1,490,804 tons, yielding 37,676,368 pounds of copper, as against the 671,990 tons, yielding 16,357,329 pounds of copper, produced by the Britannia mine, on Howe Sound. The Hidden Creek mine has a reserve of 18,139,163 tons averaging 1.61% in copper, whereas the total reserves of the Granby company are estimated at 23,193,581 tons in six different mines, of which three are in Alaska and three in British Columbia.

WITHOUT undertaking to criticize at this time, it is important to direct attention to a report of the British Committee on Trade After the War. Whether peace be near or remote, it strengthens the national resolve to work constructively upon plans for the future. An ideal crystallized in a feasible program is worth far more as a thing to fight for than an ideal floating in the haze of abstract theory. The British Committee, following lines of reasoning similar to those we have presented heretofore in these columns, opposes an attempt to apply the boycott, declaring it impracticable and inexpedient. The fact that any plan for a reconstructed world must consider the special difficulties of a transitional period is clearly stated. The Paris resolution is still made the basis for the economic outlook, and that involves trade discriminations in favor of the Allies, with the frank acceptance of a protectionist policy. It is further proposed that no raw materials, such as iron, coal, tungsten, glass, thorium, nitrates, barytes, and the like, shall be allowed to enter the territory of the countries with whom we are now at war, for a considerable period after the return of peace, and control over the industries in which these supplies are used is recommended through the medium of export duties in the countries of origin. These suggestions point toward a line of thought that prevails also on this side of the Atlantic. They are far from being practical, but they have the merit of seeking in the economic relations between the nations for a satisfactory basis on which to re-organize the world.

The Human Side of Enginerring

It is with keen pleasure that we publish the address delivered by Mr. James F. Kemp at the recent commencement exercises of the Missouri School of Mines. Our friend, until lately the professor of geology in Columbia University, is the right man to discuss the subject selected by him for the occasion; if anybody has an intelligent sympathy for the workers of the world, whether they work chiefly with hand or brain, he is the man, as his former students can testify. 'Uncle Jim' is no pedantic high-brow or academic cynic; to him nothing human is alien; to him the relations between capital and labor present aspects touched with the red blood of live men. He told the graduates at Rolla to make a serious effort to appreciate the obligations, as well as the rights, of citizens in a democracy, and more particularly the duty of educated men toward the uneducated, of employers to employees. We like his mention of the humane spirit shown by such managers as Messrs. Hjalmar Lundblom, E. P. Mathewson, and Stanly A. Easton. Generalizations are never as convincing as concrete examples, and it is well that recognition should be given publicly to those that set a good example. Much remains to be done in behalf of the toiler underground and aboveground; the 'safety first' movement has been developed to high efficiency, but there is a 'safety first' of citizenship that looks to the safeguarding also of a man's spiritual needs. Let us, by all means, protect the industrial worker from the accidents incidental to his occupation, but let us also protect him from the dangers inherent in the crudities of a poorly organized community as well as the alienation inseparable from the segregation of hordes of foreigners. The great task of Americanization faces us today as never before. If the American people are to be fused into a self-conscious nation, we must see to it that the heterogenous fragments of Europe are assimilated, otherwise this country as a body politic will continue chronically dyspeptic. Mr. Kemp offers several excellent suggestions for accomplishing this purpose. The club-house is a dissolver of unlikenesses and incongruities; it is a means for bringing diverse elements into harmonizing relationship, but it must suggest no idea of patronage. For that reason we commend the useful offices of the Y. M. C. A., or some such scheme as Mr. Albert Burch carried out at Plymouth, where the club-house, built by the Plymouth Consolidated Gold Mines, Ltd., was passed by the company to the control of a committee representing the town and the mine, through representatives elected from the townspeople and from the company's staff. Such a club, so administered, brings the members of the entire community into sympathetic touch and promotes friendly relations between the national and the foreigner. The latter will remain 'foreign' until he understands American ideas, and these he never will understand until he knows our language. A nation is a people speaking the same language and having common traditions. The traditions are the consequence of the language. Therefore the primary step in nation-making is the uniform knowledge and general use of a single language. As soon as club-houses are built, it should be practicable to arrange for classes in English at which aliens should be invited and persuaded to attend. Let it be noted that "aliens" includes those already naturalized if unable to speak English fluently and to read the national language readily, for any man that thinks in a foreign language continues alien, despite all the papers he may sign and the oaths of allegiance he may take. Language colors the mind and tinges the thought; it delivers to us the racial heritage that it has guarded and sanctified. We have a language made glorious by the flowers of an ancient and noble literature, by Shakespeare and Milton, by Chaucer and Addison, but also by one born in later times, by one that used English with the simplicity of a child, the per-

fection of an artist, the profoundity of a sage—Abraham Lincoln. Let his language be the speech of every man living in the United States.

Conserving Technical Men

When we witnessed the first rush of our brave college-boys to serve, and to save their country from invasion, we rejoiced; it proved that the spirit of weak surrender, which had been preached so long in our midst, had not destroyed the manhood of the rising generation. These youths represented the finest product of American culture, and were the sons of families in which both intellectual and moral ideals are perpetuated. We were doing, therefore, the most superbly democratic thing that could be done; we were sending the flower of our civilization to mingle with those less favored by circumstance in common devotion to the great cause of Country and Freedom. This was building for a future that was to be enriched with sympathetic understanding between men of every walk in life, men who should ever after be linked by subtle bonds forged in the heat of an unspeakable inferno. It was glorious to witness this immolation of our college men . . . . . *pro patria!* Then we reflected that a large proportion of these splendid youths represented the Nation's hope for a continuance of the work of technical detail in making and keeping ready for the great struggle before us, and for the days to come. We sounded a warning; these men could not be spared from the urgent business of using science to overcome the Enemy, who, above all things else, applies science to his work of destruction. The empiricist, suddenly and but partly trained, can never replace those grounded, as are the young men from our colleges, in the fundamentals of technology. The result would be rapid deterioration of the work done behind the lines, inferiority of equipment at the front, and the risk of disaster for us all. The appeal to restrain these technical students became general, and the War Department issued orders putting it within the power of such as might show appropriate standing in their studies to elect an assignment to continue their studies until they should have completed their academic training. This, however, has proved ineffective. The spirit of sacrifice has been re-born in America, and our young men will not exercise an option to which the slightest color of 'slacking' can be given. They still desert the laboratory and the lecture-room for the daring exploits of soldiers active in a kind of defence the reality and the heroism of which all can understand. The threatened shortage of men to command the chemical factories, the steel plants, the copper refineries, the electrical works, has become so alarming that the Engineering Council has passed resolutions that should encourage the Administration to take prompt action. This is urgently needed at the present moment, when the colleges and universities are closing for the summer. It is a time when under-classmen are most likely to enlist. The problem can be met only in the manner suggested; young men now in the course of technical training, and showing aptitude for their work, must receive orders to persist until such time as a change of policy might seem desirable.

A Message From the Front

Messages from our soldiers are becoming numerous; they are always read with keen interest and deep respect. We that stay at home take off our hats, mentally, every time they speak to us from the bottom of their hearts, as does a captain in one of our engineer regiments in this issue. We give his letter verbatim. He emphasizes the fact that this war is a colossal engineering enterprise, which therefore must be conducted on scientific principles, with eyes wide open and every faculty keenly alert; whatever the high principles and lofty ideals that stimulate the Allied peoples, the operations themselves must be actuated by the "cold, non-sentimental, non-hysterical, non-optimistic, non-pessimistic facts of science." The Enemy must be beaten, otherwise there is no hope of a world such as it is the dream of our civilization to make and to continue. We shall abstain from further comment, for our gallant friend at the front speaks beyond the need of interpretation. There is this to be said, however: between the men in the trenches and those remaining at home there is an experience that has given them a vision of life utterly unlike our own. In the current 'Atlantic Monthly,' Mr. Willard L. Sperry has written on 'The Gulf' that divides the combatant from the civilian. The letters from the men now facing death hourly in the trenches breathe a fineness of spirit and a prematurity of wisdom, in its highest sense, that are wonderful. They have descended into hell and have risen again glorified. They are different men now—not the careless youths or the irresponsible youngsters that left home cheerfully to perform a compelling duty, but prematurely sagacious and serious, fired by chivalric emotions beyond our ken, touched by a divine accolade. Despite their frequent and affectionate messages we recognize a curious reticence, a brooding over the ineffable, a background of experience that they can share only with their comrades—in silences more eloquent than words. It remains for us to endeavor to keep in touch with them, and appreciate "war's obscene blasphemy against life," to realize that "an army does not live by munitions alone, but also by fellowship in a moral purpose." If from this hideous calamity we are to extract the good that is in things evil, if we are not to be sundered in sympathy from the men that are doing the biggest thing in the world today, we must do our utmost to win some comprehension of their point of view, their new aspect of life, their new vision of the great realities. Therefore we ask those on the firing-line to write occasionally for publication in our pages, thereby creating and maintaining the links that may hold us together for the work that must be done to reconstruct industry after the War and to so cement the bonds of nationality that the American people may be unified as never before.



Man-Power

The Editor:

Sir—At the bottom of the able address on 'Man-Power', given at Boston, by J. Parke Channing, which address was reproduced from the Trans. A. I. M. E., in the MINING AND SCIENTIFIC PRESS on June 1, lies the concept of individualism as a necessary factor in the proper development of mankind. This is opposed to collectivism, which commonly is advocated as a means for equalizing social and economic conditions. Mr. Channing insists wisely upon a broader training of engineers in the humanities, which is equivalent to preparing them to understand men not as if each were a single phenomenon, but as expressive of psychological laws, whether we consider men individually or in their group relations. Fundamentally this rests on biology. It is more than psychology, for it relates to man as we actually find him, that is, in a state of change, subject both to group and to individual variation. Whether Mr. Channing meant precisely this, I believe it is fair to put such a construction upon his interesting argument. The failure to recognize this flux in mental development is a part of the cause of the persistent misunderstanding between the classes, which has been intensified since the factory system began its process of segregation of workers. Occupational differentiation, with its corresponding social classification, finally extended even to the United States, which had enjoyed a period of such liberalizing individualistic effort during the first 70 years of its existence as to seem for a time to confirm the philosophy of the Declaration of Independence in declaring all men to be created equal. Anyone who turns away from the consideration of these problems of creative evolution, on the assumption that they are merely academic, has failed to grasp the significance of the great social question which Mr. Channing so clearly recognizes as an impending legacy of trouble from the present War. His citation of the revolutionary program, recently announced by the British Labor Party, affords justification for his contention that engineers should be specially trained to deal intelligently with the man-power that is beneath and above the highest achievements of this mechanical age. I am impelled to extend the consideration of these questions, partly by reason of Mr. Channing's pleasant mention of a statement contained in my recent discussion of the economic basis of peace-compacts in the 'Atlantic Monthly'. It is true that the conclusion there reached, following a process of cold analysis of the leading causes of international friction, led inevitably to the recognition of free trade as the single road to enduring peace and persistent progress. To that extent, as Mr. Channing observes, I affirmed what the British Labor Party has more recently announced as the prime essential for world peace, but I also showed that free trade, suddenly adopted by any nation, would be the equivalent, for that nation, of committing suicide. I pointed out that free trade, rightly understood, meant non-protectionism, which is a far broader and more complex thing than the mere demolition of tariff walls. I might have gone still further, and have shown that the sudden introduction of the principle of non-protectionism throughout the world would result in the complete subjugation of those nations having the higher standard of living to the economic yoke of the nation that possessed the greatest comparative advantage in natural resources, geographic position, moderate labor cost, and effectiveness in both man and machine-power. The proclamation by international treaty of simple freedom of trade, without simultaneously striking at the subtler and more powerful schemes for protection, would be to deliver ourselves and our posterity into the hands of the conscienceless domineering Germans. The ideal of pan-Germany would then be easy to realize, making Mittel-Europa the purveyor to an outer world enslaved in economic bondage. This is what, in its blindness, the British Labor Party would inflict upon us all, if its socialistic plan were to be adopted as a universal rule. It is important to discriminate sharply between the constructive doctrines of rational social progress that are often preached by socialistic propagandists, and the principles destructive of individual initiative, which ever lurk in these programs. Social evolution and socialism are two wholly different things. We should distinguish between them, even in our nomenclature, in order to avoid confusion. One may hold advanced ideas concerning government ownership of public utilities; he may approve of the regulation of industry and the fixing of relations between labor and production, under a system that denies to men much of the assumed right to do altogether as they like with their own, and yet be at the antipodes from accepting the administrative absolutism that is involved in the schemes of the socialists. We might call the true civic reformers, who advocate the free play of social evolution, by the distinctive name of political scientists, so that they might preach progress without fear of being classed with the socialists whose fundamental concept, in whatever garb it may be masked, is the subjection of the individual to bureaucratic initiative. As an example, the very program of basic aims announced by the British Labor Party, and

cited by Mr. Channing as symptomatic of an attitude of mind that must be understood in order skilfully to combat its influence in a constructive manner by the progressive leaders of industry, is as good an illustration as any. The British laborites claimed to analyze the needs of society, and declared that the civic 'house' stood upon four pillars: the first was the national minimum, and this consisted of a minimum wage, a minimum period of labor, a minimum of leisure, a minimum provision for health, a minimum of education, and a minimum of subsistence; the second pillar was the democratic control of industry; the third was a revolution in finance, signifying virtual nationalization of all property, which in its effect upon private holdings is the same thing as confiscation; and the fourth was the diversion of the surplus wealth to the common good. What is the matter with that program? One defect in it is that it fails to represent an ultimate analysis. The principle of democratic control of industry, according to the exposition given in the document, necessitates "a genuinely scientific re-organization of the nation's industry, no longer deflected by individual profiteering, on the basis of common ownership of the means of production (and) the equitable sharing of the proceeds among all who participate in any capacity." If this were done the fourth pillar would be demolished, since there would be no surplus wealth to be diverted to the common good after the proceeds of industry already had been shared equitably among the participants. The third pillar is concerned with taxation, and is part of the system for holding industry manacled under democratic or state control. The British Labor program, therefore, reduces to the single demand for democratic control, with the national minimum introduced as a corollary. In other words, the individual would surrender his freedom of action to bureaucratic administration under an elective absolutism. There is but one pillar left; all the rest relates to the details for carrying out the restriction of the individual initiative to the will of a governing few.

About the same time that this program was issued, the French socialists held a convention and published a proclamation showing a divergent and more conservative opinion, consistent with the spirit of the French, who are the arch individualists of the age. Their program strips off the detail that clutters and obscures the issue as presented by the British laborites; the single trace of internationalism is the demand for a world-wide agreement fixing hours of labor. That strikes a note of universality because it would tend toward equalizing the conditions of competition. It is a broadly constructive idea, worthy of serious thought, squarely presenting one factor that must concern us in any scheme for universal harmony that is to prove effective in the normal progress of the nations. We must keep in mind that true national and racial advancement consists in developing highly evolved individuals, consciously reaching after the creative intelligence. Moreover, there lies in this French program the germ of the principle that must be cultivated in attaining the ideal basis of world democracy. It presupposes a gradual uplift of men in their economic relations; a gradual elevation of the human standard; and necessarily this involves economic tutelage through a disciplinary tariff destined to disappear automatically when the higher level of the workers in any industry is reached. The problem of an equalizing tariff is the most attractive for working out a practical basis for conserving the best in the development of the past and for lifting a re-constructed world toward a higher plane that I have been able to conceive. I have stated here no more than the fundamental conception; the elaboration of the detail into a consistent plan is a matter requiring larger space. It will be evident, however, that it is based on the idea of conserving and utilizing a highly developed manpower as the most vital essential in social progress.

COURTENAY DE KALB.

Stanford University, California, June 1, 1918.

Simplified Price-Level Economics

The Editor:

Sir—Under this caption Richard Hoadley Tingley, in your issue of May 4, discusses some economic principles and arrives at some conclusions which appear in part to be open to grave question. Mr. Tingley deprecates the "quantity of money" theory, and also the influence of "rapidity of circulation." They "may be well enough for the class-room" or as "good mental gymnastics," he says. In this I must disagree with him. If these theories are wrong they are not fit for the class-room, nor can they be said to be "good mental gymnastics."

One of the points at which agreement is found with Mr. Tingley is on the influence of goods, this service, to my mind, however, needing definition. That a shortage of goods usually increases the price of such goods is, of course, obvious, and hardly requires discussion.

Let us then consider the money question. We will suppose the supply of goods to remain constant but the amount of money in a given community to be doubled. To be definite, let us assume every family to have, normally, an income of five dollars per day, and say that each can live comfortably on that amount, but consuming it all. Now we will suppose the income of every family in the community to have been doubled, and that each now receives $10 per day. What will be the result? The members composing these families will have better food, more clothes, automobiles, confectionery, and there will be better homes and more waste, in short, an increased consumption. This must result in a decrease in the quantity of goods which we have supposed, for the sake of argument, to remain constant, but which actually cannot remain constant under the greatly increased consumption. Hence will follow a shortage of goods and a natural rise in price, which is directly traceable to the increase in the quantity of money.

The 'rapidity of circulation' theory may be illustrated easily by a variation in the foregoing example. Suppose the increase of $5 is not spent at all, and is promptly removed from circulation. This does not mean deposited in banks whereby it gets back into circulation, but hid-

den away, for example, in the time-honored stocking or in the hole in the ground. In this case there will be no increase in prices, and goods along with prices can remain constant. That everyone has more money is obvious, but as this money, by the assumed conditions, has lost speed of circulation coincident with its appearance, no economic effect becomes evident. If, however, people after a time begin to spend this money, namely, give it speed of circulation, there will be a depletion of goods, just as occurred in our example of the increase in the quantity of money. Thus we see that quantity of money and rapidity of circulation are real factors, and that the statement that gold and currency have nothing to do with it is open to serious question.

One of the greatest difficulties in the study of economics lies in comprehending just what money is. The difficulty, probably, is not inherent in the subject itself, but lies in the fact that from our earliest childhood we have absorbed one-sided impressions in monetary matters. From the first we have seen small coins exerting an apparently disproportionate power, while little slips of engraved paper accomplished still greater wonders. We have understood nothing of the real reasons why these little coins and slips of paper are so potent. We did not, and perhaps do not yet realize, that coins are made of gold and silver in order that they may contain intrinsic value; that they are made of definite alloys, in definite sizes and weights, fashioned and stamped with edges milled so that mutilation becomes immediately evident. In short, the coin is a commodity, accurately stamped, weighed, and tagged in order that all may readily know its worth. This analysis teaches us that this mysterious substance is after all but a commodity; and that the slips of paper, when closely examined, are but promises to deliver a specified amount of this accurately standardized commodity. Once having determined that money is in essence a commodity, it is to be expected that the laws of supply and demand apply to money as to other commodities, and as an abundance of wheat tends to cheapen wheat, so will an abundance of money tend to cheapen money. This latter condition being expressed, however, not as a depreciation in money-value, but as an increase in the price of goods, as, say, one must pay two dollars when before one dollar sufficed. Furthermore it should be borne in mind that the value of money depends, not alone upon its own quantity, but also upon the quantity of the things for which it is to be exchanged, and to ignore either factor is to be equally in error.

That the authorities in Washington hold different opinions from Mr. Tingley on the 'quantity of money' theory is quite evident from their effort to prevent trading with Liberty bonds. Whenever these bonds are used as payment for goods, they become money as truly as though they were so many silver dollars, and the general use of the bonds must tend toward an increase of prices. Mr. Tingley's argument for two blades of grass is, no doubt, sound, as is implied above. He looks with suspicion upon Government control of price. In this he may be correct. History will, no doubt, furnish him much support. But, on the other hand, monopoly and combination in restraint of trade have become so extensive and powerful that the present-day emergencies may make the policy of price-control imperative. However, it should be realized that any course which does not recognize the influence of the quantity of money is bound to be defective and is likely to defeat its own ends.

CHARLES A. PORTER.

Goldroad, Arizona, May 27.

A Message From the Front

The Editor:

Sir—I am writing this letter to you for two reasons: (1) to discontinue my subscription to your valuable magazine, and (2) to give a few impressions on the War.

(1) My subscription ran out in March. On account of needed economy and the dearth of dollars caused by my sacrificing my professional work in civil life, I am compelled to discontinue the subscription. I have a family to care for. Needless to say, I regret the action necessary.

(2) Your editorials on the War are very encouraging to us over here. It might be interesting to you to receive impressions from one who had already seen eight months service at the front, and one month in the rear. One of my fixed habits in life is to look ahead to provide for emergencies and contingencies. On all work of engineering and mining interest, the future is provided for. Kindly recall that successful engineering is based upon the application of the cold, non-sentimental, non-hysterical, non-optimistic, non-pessimistic facts of science. There is a certain job to be done: six or eight million Germans and Austrians must be killed in order that our wives, mothers, and children may dare to live and call their souls their own. The number of soldiers that the enemy has is far greater than ours and his losses are being made up in part. He must be overpowered and whipped. His armies must be driven out of their trenches and killed. The enemy's country must be entered. Berlin must be captured. The royal family must be executed for gross violations of international law.

To accomplish the above results requires material, men, artillery, aeroplanes, and food. The United States should immediately take steps to equip and maintain an army of ten million men. It is numbers that count, as well as grit and tenacity. One tenacious man may kill 10 or 15 Boches, but 20 Boches may overpower the one.

The British are calling out men of 50 years of age. Should not America bow her head in shame when only a small percentage of her men under 30 have actually been called to the colors? Are we going to wait for Britain's aged men to fight *our* battles? It would be wasting time to attempt to convince any unconvinced person that America is fighting her own fight. Any person with the slightest grain of common sense knows now, in the year 1918, what Kultur means.

True, the submarine is limiting the amount of tonnage available for shipping material. If not subdued,

it will sink more tonnage, but America is capable not only of replacing sunken tonnage but of providing more than is sunk. The American enjoys tremendously a huge task. The whole nation should take delight in carrying to success a job that staggers the world and yet contributes to life and freedom. "We must prepare the United States as though we alone were fighting Germany. Let us refrain from depending on the British navy and the French and British armies. Let our Uncle Sam assume his full responsibility as a man and say, "Johnny Bull, damn the expense, old top: I am going to finish this job. If the Boche by any lying thieving trickery should temporarily get the upper hand on your army and navy, I will drive him back into his hole, if it takes all my men up to 60 years of age and all of my dollars."

In conclusion: (1) There is still a Boche army of probably 10 millions. (2) Pay no attention to starvation and revolutionary stories from Germany. Every since 1870 the infants of Germany have been fed on 'world-empire' milk. Next year Germany will lack nothing in the way of food and material on account of the Russian debacle. (3) The Boche recognizes no authority but force. (4) Let all the energy of the United States be directed toward building ships, an invincible navy, an army of 10 million, universal military service, ammunition, artillery, aeroplanes, food, and all the accompanying paraphernalia of armies and navies. Let the people refuse to purchase any luxuries, clothes, furniture, only the bare necessaries of life. Remember we wear our clothes until they rip. We cut down all excess baggage. We carry only our professional tools. Let the people at home do as much as they can do; they still escape the chances of gas, bombs, shells, and machine-gun bullets. (5) Deal summarily with the Boche spy and the pro-Boche. Organize sun-rise firing squads for all the reptiles of that type. (6) Pray to God for success in the greatest crusade against evil that has ever been undertaken.

AN OFFICER AT THE FRONT.

Somewhere in France, April 30.

Mexican Export Taxes on Metals

The Secretary of Hacienda of Mexico has issued the following schedule of taxation upon exports of metals and minerals; the figures given being reduced to American gold per pound: gold, $21.47½; silver in bars or ingots, 63¾c.; silver in mineral or concentrates, 89½c.; copper in bars or ingots, 1.19c.; copper in minerals or concentrates, 1.42c.; lead in bars or ingots, 0.00155c.; lead in minerals or concentrates, 0.002139c.; zinc in bars or ingots, 0.005589c.; zinc in minerals or concentrates, 0.007454c.; tin in bars or ingots, 2.585c.; tin in minerals or concentrates, 2.703c.; antimony, in bars or ingots, manganese, 0.001863c. on the contained metal; mercury, 4.784 cents.

FERRO-MANGANESE is quoted at $250 per ton for 70%, with $4 per unit for each per cent over 70. For 16 to 18% spiegeleisen the price at the furnace is $70 per ton.

The Gypsum Industry in 1917

The total quantity of crude gypsum in the United States in 1917 was 2,696,226 short tons, a decrease of 61,504 tons from the output of 1916. This decrease was due to the reduction in building operations in the second half of the year. The total value of crude and calcined gypsum, however, was far greater than ever before, amounting to $10,502,509. According to R. W. Stone, of the U. S. Geological Survey, gypsum produced and marketed was as follows:

State	Quantity mined, tons	Total value of crude and calcined gypsum
California	30,552	$ 96,718
Iowa	461,864	1,837,639
Kansas	79,331	424,611
Michigan	375,803	1,549,614
New York	606,268	2,036,820
Ohio	270,538	1,223,301
Oklahoma	158,017	544,129
Texas	257,328	996,262
Wyoming	55,844	197,867
Other States and Alaska	400,681	1,595,548
	2,696,226	$10,502,509

As might be expected, the average price per ton for gypsum and its products shows a large increase over the price in 1916. The value of land plaster rose from $2.04 in 1916 to $2.74 in 1917, of gypsum for retarder in portland cement from $1.34 to $1.65, and of all grades of calcined gypsum from $3.97 to $5.55 per ton.

RAPID detection of the sulphate ion in insoluble sulphates and the identification of this ion in general is the subject of a paper by G. Deniges, in the Bull. Soc. Chim., No. 23, 1918. The method, based on the formation of yellow crystals of $Hg_3O_2SO_4$ (the so-called 'mineral turpeth') on the surface of the insoluble sulphate, is used for the microchemical identification of the SO_4 ion. As a reagent, dissolve 10 gm. of crystals of $Hg(NO_3)_2$ in a mixture of 100 cc. of H_2O and 1 cc. of HNO_3 (sp. gr. 1.39). To detect $CaSO_4$ treat 0.02 to 0.03 gm. with 2 to 3 cc. of the reagent and mix, obtaining immediately the yellow coloration. The test may be made on a slide using 1 drop of reagent. Hg_2SO_4 responds to the test almost as rapidly as $CaSO_4$, giving the same microscopic appearance. With $SrSO_4$ the transformation is slower, requiring 15 to 20 seconds in the cold, but is instantaneous on warming. $BaSO_4$ suspended in the reagent does not re-act in the cold, even after long contact; on heating to boiling a yellowish coloration results that is intensified on prolonged boiling. $PbSO_4$ is colored immediately in the cold. These sulphates are readily distinguished, even in their mineralogic forms. The precipitated $BaSO_4$ of commerce contains sufficient soluble ionized SO_4 (H_2SO_4 alkali sulphates) to give the test directly. To detect the SO_4 ion in complex mixtures, precipitate out $BaSO_4$ or $SrSO_4$ in a slightly acid (HNO_3) solution, filter, wash, and apply the test. The test cannot be directly applied in the presence of halogens.

GOLD OUTPUT of the Rand in March was 696,000 oz., compared with 714,000 in January, and 787,000 oz. in March 1917.



THE GRANBY SMELTER AT GRAND FORKS, BRITISH COLUMBIA

Matte-Settlement and Slag-Disposal at Grand Forks

By WALTER B. BISHOP

On leaving the furnaces the slag and matte are received in a series of settlers, preferably five, arranged as shown in Fig. 1. The matte is tapped into ladles that are taken to the converters; the slag is granulated and conveyed in launders, having a fall of one inch to the foot, to a bin where it is dewatered and elevated to slag-piles by belt-conveyors.

Matte Settlement. It is possible to collect most of the matte in the first settler, with decreasing amounts in each of the other four. Each furnace has three settlers exclusively, and the slag-flow from two furnaces is combined in the fourth settler as shown, continuing through the fifth settler to the granulating nozzle. This arrangement was made so as to allow a further chance of settlement of entrained matte, in an endeavor to clean the slag. As the flow of slag through the fourth and fifth settlers was doubled, it assured sufficient heat to keep them properly open. This arrangement also effected an economy in the quantity of water used for granulation, as it enabled the slag from two furnaces to be granulated at one point. There is but little loss of heat between the furnaces and the granulating nozzles. It should not amount to more than a loss of 15°C. The slag stream, when it leaves the last settler, drops into an old water-jacketed furnace-spout. This allows the stream of hot slag to be adjusted in reference to the impinging stream issuing under water pressure from the nozzle, so that the granulation is under control.

The matte that is tapped from the first settler contains about 31% copper. The fourth and fifth settlers are tapped at intervals of several days, and it is of interest that this matte is often of much higher grade than ordinary matte, sometimes carrying as much as 50%. Under the best operating conditions of the blast-furnaces a matte is made that, on arriving in the first settler, allows a product to 'chill out.' In this way the interior of the settler is filled gradually so that at about the end of two weeks, through lack of capacity, it is necessary to remove it. The 'sow' formed consists of a mixture of metallic iron and low-grade matte. For this reason it has been found by experience that a 7-ft. settler is more suited to the needs of this plant than a larger one. It is possible to pick up a filled settler, remove it with a crane, replace with a new one, and leave the furnace operations practically undisturbed. An 18 by 10½-ft. settler has been tried, but for our conditions, experience, both as to cleanness of slag and ease of operation, has been greatly in favor of a series of smaller settlers. Most of the matte is recovered in the first two settlers, while the remaining three give an abundant opportunity for further settlement.

Slag-Lined Settlers. Fig. 4 gives details of a water-

jacketed settler that has proved the best type for the local conditions. It is tapered so as to allow the easy removal of the shell from the chilled 'sow.' This is done by knocking away the clamps and lifting the steel-settler shell by the aid of the crane, away from the chilled content, which is later broken up and sent to the converters. As the slag made is usually very silicious, it is not necessary to line the settlers with highly refractory material. A lining made of the ordinary blast-furnace slag, cast direct from the settlers, has proved to be perfectly suitable for the purpose, but 21 fire-bricks are placed around the tapping jacket. A 2-in. layer of old fire-brick bats is put on the bottom and leveled off with river-sand. Inside the settler is then placed a steel

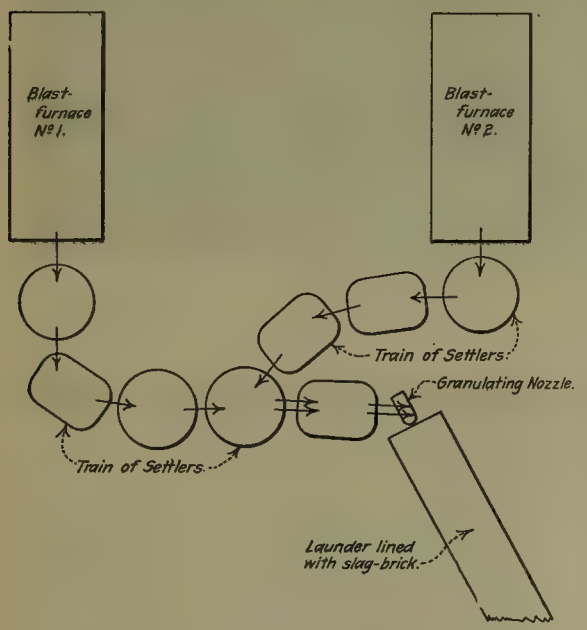


FIG. 1. ARRANGEMENT OF SETTLERS

water-jacketed circular form, tapered in the opposite direction to the taper of the settler; this form is about six inches deeper than the settler, and has a 2-in. water-space. The outer sheet is welded, flanged, and free from rivets. Clay at the bottom around the inside serves to prevent slag-leakage, and then a slag-stream is deflected into the space between the water-jacketed form and the settler-shell. This makes a slag-lining, and has done away with the need for using any brick other than that mentioned in the lining of the round settlers. The slag-wall is about 14 in. thick at the bottom and about 7 in. at the top. It has proved thoroughly satisfactory under widely different conditions as to matte-fall and slag-composition, and it gives the steel shell all the protection it requires, besides avoiding the cost of the brick and the masons' work required in laying brick in the ordinary way. In pouring a lining of this kind it is well to keep a good head of water on both the water-jacketed core and the settler itself, and also to bring the slag-lining just up to the 2 by 2-in. welded steel ring and no more, so as to prevent undue strain on the rivets at the top of the settler through expansion in this ring.

The settlers are fitted with welded, water-jacketed, matte-tapping jackets, flanged in two similar halves. These were developed and patented soon after the plant started, by Miles Barrett, the general foreman, and they have given unqualified satisfaction under all kinds of conditions.

WATER USED FOR GRANULATING. Granulating of the slag is done at four places, the slag from two furnaces

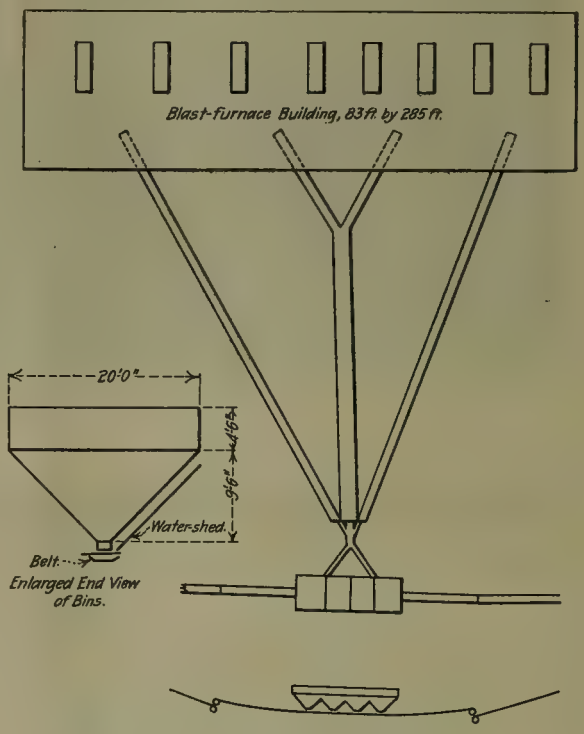


FIG. 2. LAUNDERS AND BINS

being combined at each granulating nozzle. To aid in conveying the granulated slag, the overflow water used in cooling the blast-furnace jackets and the settlers is delivered at the four granulating points. When eight furnaces are in blast there is supplied about 2800 gal. of jacket-water per minute and 1600 gal. of water at 50 lb. pressure per square inch, through four nozzles $\frac{5}{8}$ by 2 in. This is equal to 1400 gal. of overflow water and 800 gal. of pressure-water through the nozzles for each ton of slag granulated.

SLAG BLOCK LAUNDER LINING. Fig. 2 shows diagrammatically the lay-out of the blast-furnaces, launders, and slag-bins. The launders are lined with slag-blocks, which have been found to give more service than any lining material yet tried, including steels of various qualities and hardness. The same size of block is used on the bottom and sides of the launder, the free space being the full width of the block, or 18 in. Such blocks have been employed since 1913; they soon superseded other linings. Some of the blocks have been in steady service for over

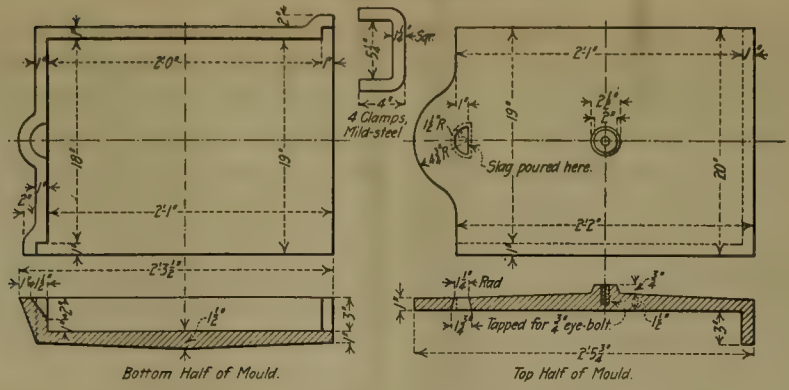


FIG. 3. CAST-IRON MOLD FOR BLOCKS OF SLAG

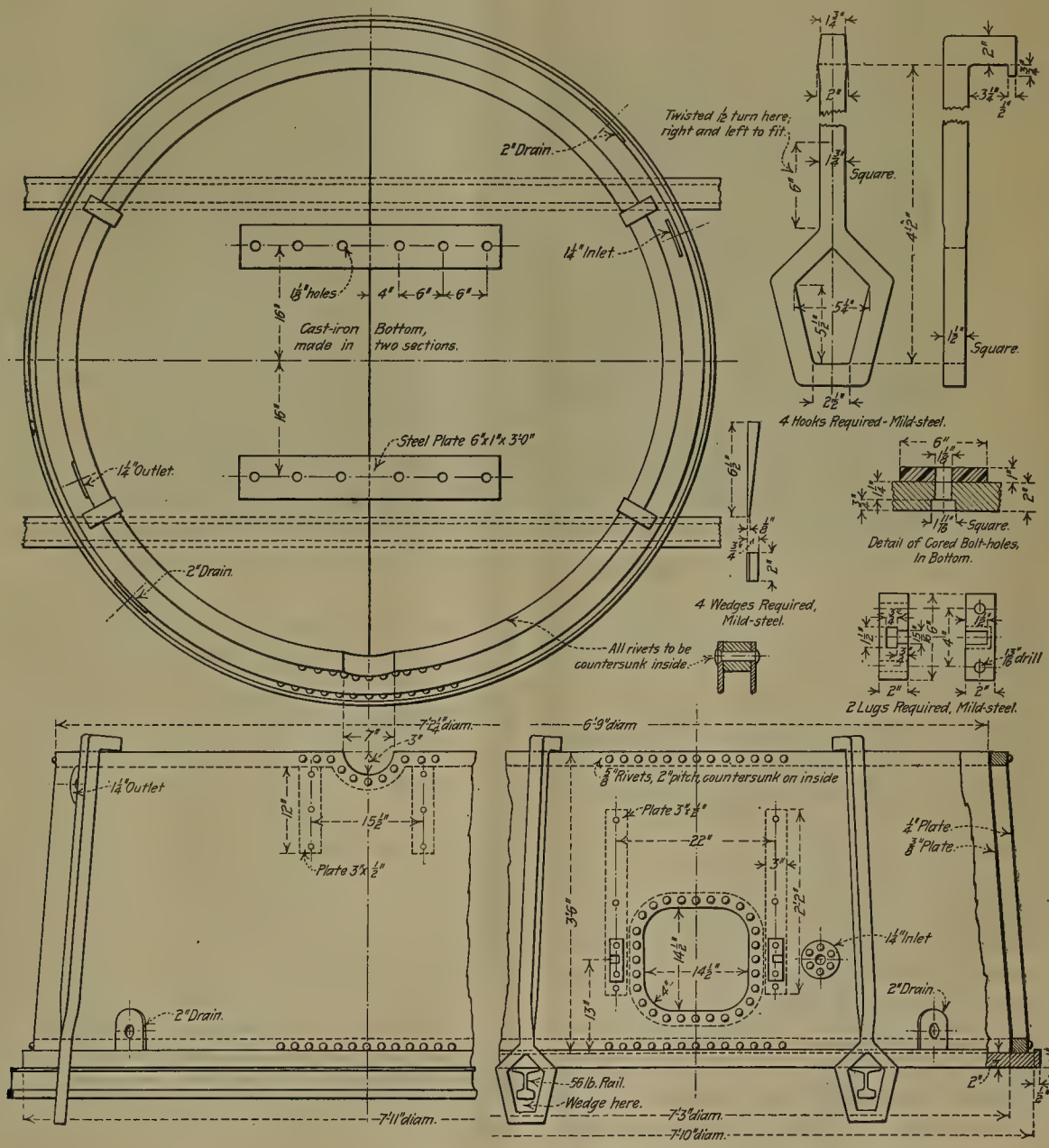


FIG. 4. TAPERED SETTLER

two years. Their use has resulted in a marked economy, both as regards the material and the maintenance of the launders. The blocks are cast in molds as shown in Fig. 3; they are 18 by 24 by 3 in., reinforced with a sheet of Trussett metal, 24-gauge, of approximately the same dimensions. We find that a slag of about 43% silica, 16% iron, and 20% lime, if cooled slowly in these molds, gives a satisfactory block. Usually a number of these blocks is cast at one time, and the blocks are then covered with at least a foot of flue-dust. It is well to leave the mold and its contents undisturbed and allow it to cool slowly under the cover of flue-dust for at least six hours. Should angular pieces be required a piece of steel may be placed in the mold and clayed at the bottom so as to prevent slag-leakage. There is but little difficulty in casting angular pieces this way, the Trussett metal being cut to the correct shape.

Slag-Disposal. The granulated slag and water is received in a bin holding about 250 tons and divided into four compartments. The water is drained off and the slag is discharged through chutes in the bottom of the bin to a belt-conveyor, which runs underneath in the direction of the long axis of the bins.

There are two slag-dumps, called the north and the south. The north dump is the one commonly used, while the one on the south is used only during repairs to the north conveyor, or for reasons of a similar nature. Including the belt under the bin, there are six conveyor-belt sections in the north system and four on the south. The belt under the bin is arranged so as to deliver slag at either end, as required, by a suitable reversing switch at the motor. The belts are 30 in. wide, 7-ply; they have a $\frac{3}{16}$-in. cover of rubber on the carrying side and $\frac{1}{8}$-in. on the pulley side. It is aimed to make a section about 310 ft. between centres and to bring the stream of slag to the belt through suitable chutes with as little concussion as possible, so as to avoid undue wear.

The first two sections of the north conveyor system were built on trestles and the slag was discharged over the end until the pile had extended from the ground to the elevation of the end-discharge. From there onward the conveyors were advanced on the slag-pile, which was formed as shown in Fig. 5. The conveyor is carried on a trestle about 8 ft. above the surface of the slag. The last section of the conveyor differs from the permanent sections in that it has an intermediate S-drive, while all the others have head drives. This S-drive can be placed anywhere along the last discharge-section of the conveyor. There are no trippers for discharging the slag, but the stream is delivered over the end of the last belt. The discharge-belt, which is called a telescopic belt, because it extends down and under the preceding belt-section, is built so that the down-hill end, for a distance of 40 or 50 ft., is directly beneath the section immediately preceding it, and the discharge end of the belt is supported on a carriage with a free movement of 20 ft. In this way, as it becomes necessary to advance the discharge end of the belt, the carriage can be jacked forward without disturbing operations, as there is always sufficient unused belt to pull up immediately below the preceding section. When this spare belt has been used up it is only necessary to drop the rear take-up car farther down-hill, insert a spare piece of belt, and continue as before. When the last belt has been extended to a distance of about 310 ft. a permanent head-drive is installed and a section made, when a new discharge-belt is constructed as explained. In this way No. 4 and No. 5 sections have been formed and No. 6 is now in process. The sections originally had an elevation of about 18½°. This elevation could be increased considerably if necessary. Owing to the limitations of the ground available, this angle has had to be varied in different sections. The slag reposes at an angle of about 40°.

Slag-Conveyor. The machinery for conveying slag is standardized as much as possible so as to be interchangeable one section with another. All drives are head-drives with the exception of the last or discharge section, which is an intermediate S-drive, as already mentioned, and also with the exception of No. 1 section underneath the bin; this, when delivering to the south, is a tail-drive, but, as the belt is practically flat, it makes but little difference. Each section is operated by a 75-hp., type C, Westinghouse motor, with the exception of the section underneath the bin, which is equipped with a 30-hp. motor. The head pulleys, of 48-in. diam., are crowned and lagged. It is advisable to have not less than 6 in. diam. of pulley for every ply of belt wherever possible. Carriers are spaced at 5 ft. centres and return-rollers have 10 ft. centres. Side-guide rollers are spaced at 20 ft. centres; they are put there more for precaution than for use, the object being to run the belts at all times so as not to touch the side-guide rollers, thus preventing undue wear at the edges. The return-rollers are made from 6-in. pipe in one piece, with the bearing pressed into the ends of the pipe. They have proved successful. When built of several sections, as formerly done, they formed tracks in the carrying surface of the belt.

Motor-controllers for the north system of belts are all placed in a house at the beginning of the No. 3 section north. This allows one man to control all the operations from a convenient point. Controllers for the south section of belts are placed at the beginning of the No. 2 section south. A light cable attached to a safety-switch runs the entire length of the conveying system, enabling operations to be stopped immediately from any point in case of necessity. Telephones are installed at convenient places.

The power used on the No. 3 section north, when running unloaded, is 16 hp., and when loaded is 64 hp. As the power used in moving the conveyor without load is such a large proportion of that when loaded, it is well to run the conveyor as fully loaded as possible. This also reduces the wear on the surface, because a less amount of material is brought in contact with the wearing surface of the belt. In this way, with eight furnaces in operation, and moving about 2880 tons of slag per 24 hours, all the slag made on an eight-hour shift is handled in about 3½ hours running time. This allows plenty of time for cleaning-up and oiling machinery. All belts, with the exception of the end-discharge belt, are run at the speed

of 500 ft. per minute. The end-discharge belt travels at about 700 ft. per minute. The object of this is to move the old and worn-out sections of belt to the end-discharge. In this way, when these old parts of the belting have been advanced this far, they are thin and usually much narrower than the original 30-in. belt, and have to be driven faster to take care of the load coming upon them. On one section of belt the slag from 2,250,000 tons of ore was carried before it was moved to the last section. On another the slag from 1,800,000 tons of ore was carried before it was sent to the end-section. The slag would amount to 80 or 85% of the above tonnage. The manufacturers of rubber belt have shown great interest in the solution of this conveying problem, and the belts have been steadily improved as to durability. It is expected to improve upon the above tonnage in the future.

Various schemes have been tried for brushing the belt so as to free the carrying surface perfectly. None has given such good service as a scraper made from belting, which is given a light pressure against the surface and is placed just back of the head pulley on the under side, provided with an adjustable spring-tension. The strip of belt is held in wooden clamps and is replaced when necessary. Suitable take-ups at the rear ends are supplied for each section. Chutes are built so as to prevent as much as possible the pounding action on the belt produced by the stream of slag when being discharged from one section to another, and they are also arranged so as to load it with a clear space of 1½ or 2 in. on each side.

The conveyor is supported on a frame-work above the floor of the conveyor building, no decking being interposed between the upper carrying belt and the lower returning belt. Under these conditions, if the slag is properly drained in the bin and is loaded correctly, there will be practically no 'slop' or over-running. The carriers are so placed as to allow ready adjustment, which is a great help in maintaining the proper troughing of the belt. There is 3200 ft. of belt in use on the six sections of the north system, and 1900 ft. on the four sections of the south conveyor. The belt under the bin is common to each system.

Labor for Each Eight-Hour Shift. One man is in charge of the bin, and two are in charge of the conveyors. In addition, on the day-shift, one carpenter and two helpers look after the repairs and extensions.



ANOTHER VIEW OF THE GRANBY SMELTER

The cost of handling the slag—including power, repairs, maintenance, labor, and extension—is as follows:

	Ore, tons	Cost per ton, cents
12 months ended June 30, 1915....	617,544	3.8
12 months ended June 30, 1916....	1,106,115	3.8
12 months ended June 30, 1917....	685,050	5.6

Nearly all the slag up to 1912 had been poured in a molten condition, being run into pots and hauled by small locomotives to the various dumps. After that time, owing to a shortage of dump-room, the slag was granulated and disposed of as explained above. The design was made under the management of F. M. Sylvester, vice-president and managing director, with the supervision of W. A. Williams, superintendent of smelters. Charles Wekell, the master mechanic, had charge of working out a great many of the mechanical details.

Copper ore concentrated in 1916 amounted to 50,935,355 tons, and ore smelted, 6,928,010 tons. The former contained 1.28%, and the latter 4.72% copper.

Iceland Spar in Montana

By CHARLES R. PARSONS

The existence of large deposits of pure calcite has recently been brought to the attention of the Bureau of Mines. These occur near Gray Cliff, Montana, and have been inspected by S. C. Lind, of the Bureau. At the present time there is no considerable market for pure calcite. It is used for the manufacture of some kinds of glass. Perfect crystals of calcite are employed in certain optical instruments. In the past practically all the optical material has been mined from one deposit in Iceland. The crystals from the Montana deposit appear to be the nearest approach to Iceland spar yet uncovered in any part of the world. Since the seventeenth century scientific requirements for optically perfect calcite has been supplied almost wholly from the small deposit on the east coast of Iceland. This consists of a cavity in basalt completely filled with enormous crystals of pure calcite. Rhombohedrons and scalenohedrons, with diameters as great as three feet, have not been uncommon. In recent years, however, the difficulty in securing first-class spar from the Iceland deposit has steadily increased.

While the total amount of spar required is not great, the maintenance of a certain production is necessary for the manufacture of Nicol prisms to be used in dichroscopes for testing pleochroism of gem stones, in polariscopes, in polarizing microscopes, and in saccharimeters. Other substances having as great a difference in the refractive indices of the ordinary and extraordinary rays are all unsuitable for replacing Iceland spar in optical instruments.

It is possible that the Montana veins might be made to yield a commercial product if worked with care. From one of them 600 lb. of crystals are said to have been shipped to Germany, where they sold for $3000. These crystals had been sorted from about 40 tons of calcite. The Montana deposit lies in two vertical veins in gneiss. The veins are four to seven feet wide, probably at least 100 ft. deep, and are several miles long. The deposits are near the surface, easily mined, and accessible to the railroad. The crystals practically fill the entire vein without any admixture of foreign intrusions. Some crystals have a slight gray cloudiness which renders them unsuitable for optical purposes.

ZINC OXIDE produced by the French process commands 14c. per pound in carload lots and 14½c. in smaller quantities. American process grades are quoted as follows: standard at 10c. in carloads, and 10½c. in less than carload lots; sterling at 9¾ and 10c., respectively; superior 9¼ and 9½c. respectively; and Lehigh 9 and 9¼c. according to quantity.

ALUMINUM SALTS produced in the United States last year amounted to 198,452 short tons, a decrease of 28%. Alum decreased considerably, but aluminum sulphate increased. These sold at $51.60 and $32.15 per ton, respectively.

Recent Zinc Patents

Zinc ore, according to U. S. patent 1,255,438, granted to F. Laist, when containing iron, is calcined, leached with H_2SO_4, the iron is precipitated by the addition of material containing ZnO, for example, calcined zinc ore, and the precipitate, after separation from the solution, is heated in a furnace at a temperature below that of calcination (preferably not over 625°C.) to render the ferric compounds insoluble without substantial decomposition of the $ZnSO_4$, and the latter is then extracted from this product. Modifications to meet other conditions are covered by addition patents to Mr. Laist and to J. O. Elton. No. 1,255,436 specifies that zinc ore containing arsenic or antimony is leached with an acid solution containing ferric and manganese salts, and the solution is electrolyzed to precipitate the zinc. After electrolysis ferric and manganous salts are introduced into the solution in sufficient proportion to eliminate the arsenic and antimony, and these with any iron are removed by precipitation before further electrolytic treatment. The spent electrolyte may be re-oxidized and used for leaching additional ore. By patent No. 1,255,439 the zinc ore is leached with an acid solvent, the iron precipitated from the solution as a ferric compound, and the resulting solution is treated with finely divided zinc to precipitate such metals as copper and cadmium, which are electro-negative to zinc. The zinc is electro-deposited in spongy form from the solution to effect further purification of the latter, additional zinc is deposited as reguline metal, and the resulting acid solution is re-used for leaching ore. Recovery of other metals is the subject of patent No. 1,255,440, for use when the ore may contain zinc, lead, copper, and precious metals. It is roasted and leached with H_2SO_4; the solution obtained is purified, and the zinc is recovered electrolytically. The residue containing the copper, lead, and precious metals and some zinc is smelted, producing a matte containing the copper and precious metals, and a fume consisting largely of oxides of zinc and lead. The zinc is extracted from the fume by dilute H_2SO_4, leaving a residue high in lead, and the copper and precious metals are recovered from the matte.

Another patent for extracting zinc from ores, No. 1,256,802, has been granted to E. A. Johansson. By this method a charge of zinc ore containing sufficient carbon to unite with the oxygen of the ore to form CO is introduced into an electric resistance-furnace and an electric current is passed through a portion of the charge so that different parts of the charge are heated to different temperatures. The CO_2 formed in the cooler portion of the charge is caused to penetrate successively the hotter parts of the charge so that the remaining unaltered carbon will reduce the CO_2 to CO. This avoids detrimental oxidation of the zinc by CO_2

LITHIUM MINERALS (amblygonite, spodumene, and lepidolite) mined in this country in 1917 totaled 2062 tons, valued at $42,912. California and South Dakota produce these minerals.

The Human Side of Mining Engineering

By JAMES F. KEMP

*In this year of our Lord nineteen hundred and eighteen, you are holding Commencement under conditions different from any previously experienced by the School of Mines. Under those which have hitherto prevailed a scientific theme would be appropriate for this address. There are many such. Geology has so enwrapped itself in the very fire of the mining industry that the themes concerned with structure and origin are fundamental. Yet in this period of hot volcanic feeling, when all over the broad land that with solemn pride we call our own, all good men and women are asking but one question, what can we do to serve, it is the human questions which alone seem appropriate for discussion, and it is to the human side of relations between workers, whether they are in the office or in the mine, on the surface in the sunshine and the daylight or underground with the searching ray of the carbide lamp, that I desire to direct your thoughts. You who graduate today just as those who have taken their diplomas at previous commencements, will sooner or later have to meet the problems presented to and by the workers. You observe that I make no distinction among workers. We are all workers.

The old relations which have prevailed among the people engaged at our mines, even if they be of but modest size, have not proved all that our bright fancy might paint. They are not all that could be wished, but as time goes by they will undergo improvement. Many thoughtful observers realize this truth to the full. At the annual dinner of the American Institute of Mining Engineers last February, president-elect Sidney Jennings, in announcing the subject which he planned that the Institute should specifically discuss during his year of office, selected the human side of the industry and the improvement of conditions. It was a striking coincidence, of which Mr. Jennings was not, I believe, at the time aware, that only a few days before in a pamphlet issued to his people, President Shonts of the Interborough Company, which controls in large degree the subways and elevated railroads of New York City, had taken the ground that the human side of their relations must now come up for more serious and continuous attention and for improvement.

These problems are fundamental and the fundamental nature of them comes home to us with exceptional force at a time like the present, when we are all called to rise as one man to the defence of our country. We have prided ourselves on the fact that every citizen in it could truthfully say and feel "it is my country," and could have good reason for the belief that is in him. Its normal conditions assured him reasonable justice and a fair opportunity to work out his own career. We solve our problems of government with human and necessarily imperfect instruments. Imperfect and partial results are obtained. But the great, important and basal feature of it all, is the conviction deep down in each individual's mind, that he has a free and fair field, and that where wrong exists, as wrong is bound to exist more or less in human life, means are also provided wherewith to right it. If therefore not in war times but in normal times, we can labor to strengthen that fundamental conviction, we prepare for those sudden, almost unbelievable upheavals, veritable earthquakes in human affairs, such as the present one with which German ambitions and unbridled selfishness have confronted us. Our people are responding with such widespread singleness of purpose as to convince us that the course of life in the past in America has prepared a united front in the defence of democracy against its most dangerous, unscrupulous, and insidious foe. President Wilson has gone right to the heart of the matter and his epigrammatic and concise summaries have the convincing force of proverbs, for a proverb, you know, has been acutely defined as the wisdom of the many but the wit of one.

We are to consider for a few moments the ways in which a mining engineer can so conduct the enterprise under his control or in which he shares as to secure the loyalty of all the workers to the company or firm controlling it; and to make them good and loyal citizens.

Mining and metallurgical enterprises in a large proportion of cases differ from other industries. They are often in remote places. The community is built up around the mine or group of mines or around the smelter. The manager must not only employ and pay, but house, feed, and educate. Let me give you one or two illustrations, not necessarily drawn from America. When the International Geological Congress of 1910 was held at Stockholm, in Sweden, an excursion was given the delegates far to the north to the great iron mines at Kirunavaara, situated over a hundred miles north of the polar circle in Swedish Lapland. At Kirunavaara—under the leadership of Dr. Hjalmar Lundbohm, formerly of the Geological Survey of Sweden—there had been developed a huge sheet-shaped mass of magnetite that is very nearly if not quite the largest single body of iron ore yet discovered the world over. A remoter situation could hardly be conceived, nor, in the winter, severer climatic conditions. From a great though somewhat diversified plain there rises to a height of some hundreds of feet the ridge whose backbone for several miles is the great sheet of iron ore, lying with a dip of 70° between other sheets of contrasted eruptive rock. At the foot of the

*Commencement Address delivered at the Missouri School of Mines, at Rolla, on May 24, 1918.

ridge in 1910 a community of 5000 souls had been established. There were 1000 children in the schools, and the school-houses, in which the eight or ten score excursionists were fed, were beautifully constructed and equipped. The houses of the workers were comfortable and convenient, so that to the most superficial observer it was evident that Dr. Lundbohm had been moved by an almost pastoral care of his flock.

On the day on which we were conducted along a mile or more of the outcropping ore and while the other members of the party were busy collecting from the ore, the hanging wall, and foot-wall, I sat for a brief space apart by myself and studied over the Arctic expanse of stunted trees, moraines, swamps, and lakes. But continually my thoughts would come back to those 5000 people, men, women, and children, all drawing their support from the mine. There they were, placed right in the hand of the general manager, and his opportunity as well as his responsibility for more than food and clothing were very great. There was a little organized state in miniature, and much more than Swedish kröner in dividends was involved in the way their lives were directed.

Let me ask you to turn your eyes next to the West for two more illustrations. The flourishing little city of Anaconda, in Montana, gathers around the Washoe smelter, or as the company now officially calls it, smeltery. You could not be a half-hour in Anaconda without hearing the name of E. P. Mathewson, until recently the manager of the works, and now moved by the exigencies of the War and his Canadian citizenship to develop a new company for the production of nickel, in the Sudbury district, Ontario. But Anaconda is Mr. Mathewson's masterpiece—and we see not alone a great and thoroughly organized smelting plant, but good homes, good roads, a park, a fish-hatchery, and a hundred other signs of wise and far-sighted management. One also finds a singularly devoted staff of workers, reaching into the thousands and animated by one spirit of loyalty. We understand why the Mining and Metallurgical Society of America awarded its gold medal to him in 1917. Mr. Mathewson passed on to his successor not alone the management of the great works but responsibilities not unlike those of the bishop of a diocese.

Were you to go farther west to the valley of the South Fork of the Coeur d'Alene river, deep down between the mountain ridges of Idaho, you would find the trim little town of Kellogg, adjoining the mines, mill, and smelter of the Bunker Hill & Sullivan company. Homes for the workers with a plot of ground, which can be bought from the company under favorable terms, are the striking features to a visitor. Instead of the slovenly cabins and unattractive boarding-houses so often the rule in Western mining camps, one notes comfortable homes with little gardens in which a miner and his family may take pride. In these as well as in other ways in connection with this mining enterprise, the wisdom of Mr. Stanly A. Easton's far-sighted management become impressed on an observer.

As I have stated, mining and metallurgical communities are relatively isolated as compared with those dependent on other forms of industry to a degree not often the rule in other lines of employment. The miner also works either by himself or in small groups, usually underground, often in confined places, which may be wet, or sultry and hot, and which often involve some personal risk. The air is frequently bad. We cannot wonder if, when he comes to the surface, the miner, more than other workers, craves excitement and change. If a saloon is available, the poor man's club, as it has been wittily called, he resorts naturally and inevitably to it, and in the social companionship of his fellows, seeks in the artificial excitement of stimulants the change for which he not unnaturally longs. If he is in a small and isolated place, there is nothing to do in the evening or other off-shift part of the time, but to sit around the bunk or boarding-house, where rarely is there provision of magazines or illustrated papers; and where a hand at cards furnishes almost the sole recreation. In such instances, and they are legion in the West, he waits till the end of the week or month, and condenses into a few wild hours the accumulated and not unnatural cravings of days or weeks.

Something surely can be done to meet in a proper and unobjectionable way a need that none can deny. Club-houses or club-rooms at once suggest themselves as the natural solution. Prohibition will soon wipe out the open and above-board saloon and reduce almost to the vanishing point the old means of indulgence. The need of some substitute will be more imperative in the near future than it has been in the past. A social centre must be provided. Magazines and illustrated papers are something. Games of cards without money-stakes have no real objections and would be enjoyed by many. A social glass of non-alcoholic drinks will answer for good fellowship as well as does fire-water, if prejudice can once be overcome. A quiet smoke over an open fire in congenial groups in comfortable chairs is no impracticable dream. Something like bowling-alleys or billiards suggest themselves at once.

All these, however, must not be provided as a gratuity or donation by the management, for, if so, they would thwart their own good purpose at the outset; but they must be run like any club by the members, all sharing. Expenses must be borne in some reasonable division by participants. The sense of ownership and responsibilty must be cultivated, otherwise in the American atmosphere movements of this kind made with the best intentions by the management of companies or the heads of firms have proved flat failures. I recall one beautiful memorial club-house erected by the families of two departed members of a great firm in a somewhat isolated mining town and placed under the charge of a well-meaning and devoted retired clergyman. The reverend gentleman thought it wrong for the men to play cards or smoke in the building and hedged it around with such restrictions that no miner could have been dragged to its door by the police.

A strong and successful movement for the establishment and acceptable management of club-houses and social centres by the Young Men's Christian Association

has been for some years in progress and has been in instances very successful. The club-houses which were placed under its auspices at all the communities of workers along the Panama Canal during its construction were invaluable and a great means of good. Conditions there were similar to those at many great but isolated mines. Bowling-alleys, amusement-rooms, and reading-rooms furnished veritable oases in the desert and were a great source of good. Similar club-houses are not unknown in mining communities. One at Miami, Arizona, has for some years kept open hospitable doors.

These social centres must be managed with care in one respect, since miners are of all religious faiths and none, of all nationalities and often of strong prejudices, and the social worker in general charge must have so broad and comprehensive a human spirit that his love for his fellow-man as men, is not fenced in by limitations of creed. A very useful help in good works around a social centre can be found in the omnipresent fondness of Americans for outdoor or indoor wholesome sport. Teams from neighboring mines, or from different shafts of the same mine, or from surface-men and underground men, or from any other groups who form natural centres, can be recruited and be a fruitful source of proper entertainment. There may not always be level ground for baseball, or 'soccer,' but the narrowest valley is not so narrow as to crowd out quoits; and in a club-house the bowling-alley may furnish a safety-valve for much good-natured rivalry.

You cannot fail to note that I only urge for mining communities what has sprung up naturally and universally as adjuncts to our training and fighting camps of troops, here and abroad—social centres, reading-rooms, athletic fields and sports, inter-regimental, divisional, or other rivalry at base-ball, and other games—all operating for good discipline and making lighter the disagreeable features and monotony of a soldier's, as they would also of a miner's, life.

One feature of our Western mining communities cannot fail to impress one who lives in them. It is a feature less marked in the older and more settled districts of the East and of Lake Superior. It is the wide-spread feeling that the community is a transient one; conditions are temporary; ore will be exhausted and everyone will move on elsewhere. The disposition is thus to accumulate a stake and depart to some other place in which to settle down. Where mines, however, are known to have great reserves for years to come, one of the most important efforts of the management might well be to break this feeling and get all concerned to look upon the community as their settled home. Now, the foundation of the State, as we all well know, is the family. Unless we have a vast predominance of reasonably happy and contented families, in which young people grow up under wholesome surroundings, we cut off at the source our supply of good citizens, men and women. Our so-called and significantly called, mining 'camps,' have too little family life and are too little populated by families and too much by hobo miners. A most important phase of the whole subject is for the management of the companies that are large enough and permanent enough to justify the movement, to give no small part of their attention to establishing comfortable and reasonably attractive homes, which, where possible with a little tract of land, may be acquired by a miner and be felt to be his own. There is no stiffener of backbone or strengthener of character greater than owning a piece of land and in spare times growing supplies for the table from a bit of a garden located upon it. The miner with a home and a family has a stake in the game and becomes a self-respecting citizen. Not every mining locality is adapted to this development. The great Utah Copper Company, brought into successful operation by your distinguished graduate Mr. D. C. Jackling, is placed far up the narrow Bingham canyon, amid physical conditions precluding little homes and gardens. Suitable land in the dry climate of Utah is too far away to admit of transportation to and fro. But at Kellogg, in the Coeur d'Alene, as I have earlier stated, the Bunker Hill & Sullivan company in a broader valley has accomplished impressive results in building and selling homes to the men, at attractive and reasonable terms. No doubt there are other instances, but, in general, where settlements can be feasibly established in reasonably flat and open country, within practicable distance for transportation, to and fro, we must feel that no more important development could be carried on by the management than to give its attention and a part of its resources to the housing of its men under these circumstances. A company could thus assist in carrying out the scriptural injunction of setting the solitary in families. We would reproduce in this way some of the attractive features of the mining towns in Cornwall, the mother of metal mining among English-speaking peoples, and of Wales, to whose miners we so largely owe the early development of our coal-fields.

The Welsh have another suggestion to give us. They are remarkable singers in chorus, a characteristic not only of the Welsh in Wales but of the Americans of Welsh descent in Pennsylvania. In England, in the contests which have been held in former years by choruses from various parts of Great Britain, the Welsh have been almost invincible. The Cousin Jacks are rather notable singers of hymns in the old country, nor has it been altogether unknown in former years, to have groups of good Methodists from among them in the Lake Superior copper mines, start up a hymn as they were lowered in the cage down the deep shafts of this region. Italians are famous as a people of song—and they furnish no negligible part of our miners today. Folk-songs are also characteristic in the villages of many other lands which send us miners. I cannot believe it is an impracticable pipe-dream that some of these latent possibilities of song and choral singing could be developed under the bright skies and amid the impressive mountains of the West. Children at all events, where they are members of a mining community, have great possibilities for choral singing under proper instruction. Last winter in a little town in Florida, we sojourners seeking relief from the rigors of a northern winter and our neighbors who lived there all the year round, were gladdened and raised quite

out of the dead level of life amid the sand-dunes, because a cultivated English woman, of early musical training, brought the children together for some weeks before Christmas and taught them the beautiful Yuletide carols of the old country and of other lands. Had you heard, as I did, the old-time English songs, the Noël of the French, and the Holy Night, the product of a long-vanished time in Central Europe, you would have wrung the teacher's hand as I did, in congratulation over her happy thought. While there are youthful trebles, there must unquestionably be sonorous basses and high-pitched tenors in our larger mining communities awaiting the magic touch of the conductor's wand.

In all organizations of men which hold effectively together we need some sort of reward and some sort of recognition for long and good service. To a certain extent these rewards come now in promotion for those who show qualities of leadership that make them available as shift-bosses or foremen; but only a man here and there is adapted to these positions. The general run of men work on with no possibilities of recognition. I have pondered the question a bit, as to whether some progressive recognition could not be provided by some increase in pay or some keepsake that would commemorate it. I realize that to some, perhaps a serious, extent class-feeling and the disposition sometimes shown by unions to keep all their members on a dead level of compensation would militate against it. And yet the system of rewards for good work appeals to just as deeply ingrained a characteristic of human nature as does discharge or other penalties for poor work. In almost all cases we have the latter, but we seldom hear of the former. Are we not thereby overlooking an important phase of the whole question.

In a recent address to the Montana section of the American Institute of Mining Engineers at Butte, to which in common with many others I listened with deep attention, President Jennings of the Institute emphasized the great importance of getting the workers of all sorts in our mines and smelters to exercise their wills for the good of the organization. He defined the problem as one to secure the wills in the service of the employer. Perhaps in the topics that we have already covered there may be a suggestion or two leading to this end, in so far as all the points made emphasize the importance of supplying conditions of life conducive to reasonable satisfaction and contentment. Mr. Jennings touched on another phase which is one that I have often pondered, as doubtless have others, and that is summed up in the employer's privilege to hire and fire at will. This is a privilege often exercised very harshly by shift-bosses and minor officials, and, as Mr. Jennings pointed out, it starts a man away from his means of support, breaks up his home if he has one, and causes him injury often quite disproportionate to his offence. He may be a poor miner and be not adapted to the work of this particular type, but he may be well enough adapted to some other branch of employment. It is well, therefore, to think seriously whether, if a man is reasonably industrious and otherwise deserving, some kind of work suited to him cannot be found before his connection is absolutely severed. In other words, can we not introduce the human element into mining engineering? Shift-bosses and minor officials are often greatly impressed with the powers of authority and are sometimes harsh and hasty in its exercise. On the other hand, discipline must be maintained. Perhaps I may commend to you as a subject worthy of a little serious thought whether there is not some way possible of maintaining necessary discipline and yet supplying a tribunal of some sort which will command confidence and which will give a fair hearing to cases involving at least the temporary loss of livelihood. I am inclined to think that the most important part of the Safety First movemen is one to which, so far as I know, practically no reference has been made under this watchword, and that is the safety of a deserving man in his job. The one great thing to keep out of his mind is the smarting sense of wrong and injustice. The fierce individualistic conditions of a new country like our own are fast giving way to more settled ones such as prevail in older nationalities. The sense of security in a job is greater in the older communities, and it has its good side even for the more restless and changing side of our own.

Some of our smelting companies, such as the United States Steel and the International Nickel, have sought with good results to make all the workers participants in the returns of profits. Shares of stock in the several companies have been offered the workers on favorable terms and under such conditions that a portion of the monthly wage could be applied for their purchase. A community of interest is thereby established and much has been done to attach to the company's welfare the 'wills' of the men—the securing of which Mr. Jennings described as a step so greatly to be desired. This plan also meets a condition laid down by President Ripley of the Santa Fe railroad at a dinner given in his honor at Chicago on his seventieth birthday. He established as a principle in the management of great enterprises, such as his own, that changes or improvements must be so planned as to be to the common advantage of all concerned. We know well that this applies also in mines and smelters and finds expression in sliding scales of wage based on the market-price of metals. A rise in price that is accompanied by benefits all round leads to satisfaction rather than discontent. A fall in price leads to suffering to all concerned. While, alas, experience shows us that the spiritually beneficial effects of the latter form of suffering are less appreciated by the wage-earners than the stockholders, yet, after all, kinship is established by this touch of nature.

Gentlemen of the Graduating Class, it is an ancient profession and a great work to which in time and as you reach places of responsibility you will be addressing yourselves. If you gain the positions of management, as past experience with graduating classes leads us to think you will, the problems outlined in these last few minutes will come up for solution. Others have found a way. Let me wish you all success in so doing and by way of encouragement I will close with an incident. On May 12, 1907, in the New York botanical garden we celebrated

the 200th anniversary of the birthday of the great Swedish botanist Linnaeus, the Father of Modern Botany, by dedicating in his memory a beautiful bridge over the Bronx river. Not a few distinguished citizens of Sweden were there and some were entertained at lunch by the authorities of the garden, of whose board of scientific directors I had been a member for 15 years. The honor fell to me to serve as escort at the lunch to his Excellency Mr. de Lagerkrantz, the Minister of Sweden to the United States. For fifteen or twenty minutes we did our best to carry on a conversation that would be of mutual interest. Unavoidably the task grew somewhat labored, when a chance remark revealed the fact that in his home Mr. de Lagerkrantz owned and operated iron mines. Like magic the conversational situation changed and the luncheon came to an end before we had either of us said half the things that rose in our minds. One remark of his Excellency I never forgot. He said that when he was leaving his home amid the iron mines to start for America, his men came down to the train to say good bye. With tears in their eyes, they bade him not to tarry long in America, but to return to his own people as soon as he could. The manager or the owner of a mining enterprise sometimes, as you see, has also been the guide, counsellor, and friend of his people.

The really great man, whether in national life or in the responsible places in industry, is the one who understands his people and gives his best endeavor to surround them with such conditions that their reasonable and proper aspirations may find expression. Of all the men of prominence whose lives have come within the ken of people still living, our venerated President Lincoln is the one who best meets these conditions. Whether we come from the South or the North we must look back from the vantage ground of fifty years almost in wonder at the calm poise which always looked into the future for a united country of devoted citizens from whose hearts and minds the hot passions of war would vanish and in whose thoughts more wholesome, more helpful, onward-moving plans would take their place. In the same way, in industry the large-minded and far-seeing manager is one who to be sure does not fail to realize that mining is a business conducted for profit, exposed to competition, subject to strikes, often to unreasonable demands from the ignorant or the unscrupulous, but who does not thereby become blinded to the fact that he has in his employ not merely hands but souls, not merely instruments from which to extract a full amount of work for the current wage but citizens, the foundation of the State. As he interprets and meets their good aspirations, ensures them just rewards, realizes that only a pair of stout hands and a job stand between them and want, that many are ignorant, that many are in a foreign land with small command of its language, with smaller knowledge of its customs, its history, its life, exposed often to petty graft almost impossible to detect and eradicate, he is called upon to exercise scarcely less than the far-sighted patience and the faith which we see in the deep-set sad eyes of our first martyred president.

Copper Production in 1917

The smelter production of primary copper in the United States during 1917 was 1,886,000,000 lb., which, if compared with the production in 1916, 1,928,000,000 lb., shows a decrease of 2.18%. The total value of the output in 1917, at an average price of 27.3c. per pound, is $514,910,956, against $474,288,000 in 1916.

In the following table the production is apportioned to the States in which the copper was mined. The figures represent the content of fine copper in the blister produced, and the smelter output of ingot and anode copper from Michigan.

	1914	1915	1916	1917
Alaska	24,985,847	70,695,286	113,823,064	84,759,086
Arizona	382,449,922	432,467,690	694,847,307	719,035,514
California	29,784,173	37,658,444	43,400,876	44,933,846
Colorado	7,316,066	7,272,178	9,536,193	10,054,951
Georgia	.....	.....	803,699	930,691
Idaho	5,875,205	6,217,728	7,248,794	6,446,224
Maine	.....	.....	.....	34,872
Maryland	12,248	15,426	126,965	291,501
Michigan	158,009,748	238,956,410	269,794,531	268,508,091
Missouri	53,519	306,406	377,575	407,141
Montana	236,805,845	268,263,040	352,139,768	276,225,977
Nevada	60,122,904	67,757,322	100,816,724	115,028,161
New Jersey	.....	.....	4,115	.....
New Mexico	64,204,703	62,817,234	79,863,439	107,593,615
North Carolina	19,712	33,383	5,961	125,004
Oregon	5,599	797,471	2,433,567	1,105,097
Pennsylvania	422,741	.....	904	115,000
South Carolina	.....	.....	.....	210,000
Tennessee	18,661,112	18,205,308	14,556,278	16,093,757
Texas	34,272	38,971	86,463	2,061,129
Utah	160,589,660	175,177,695	232,335,950	227,840,447
Vermont	.....	23,995	324,400	102,522
Virginia	17,753	50,008	1,066,143	146,912
Washington	683,602	909,661	2,473,481	2,051,416
Wyoming	17,082	351,871	1,784,351	2,019,767
Undistributed	65,479	.....	.....	.....
Total	1,150,137,192	1,338,009,527	1,927,850,548	1,886,120,721

PREVENTING electrolysis of iron in concrete, according to W. A. Del Mar and D. C. Woodbury in the 'Electrical World,' may be accomplished as shown by laboratory tests on iron set in concrete blocks, which demonstrated that the resistance was located at or near the surface of the anode and that the primary cause was the corrosion of the iron. A current of 15 amp. moves 1 cc. of water in four hours through 10 cm. of rust in a U-tube of 7 mm. diam. Reversal of current causes shifting of the water back to the other branch of the U-tube. The rust near the anode becomes dry, and the moisture is driven out except near the cathode surface. Tests with painted iron bars show that when a current is passed through it, a film of paint undergoes a change in resistance. Making a painted-bar cathode in a water bath and observing the formation of water bubbles under the paint-films shows the phenomenon to be due to endosmose. No blisters are formed when the bar is made the anode.

GOLD OUTPUT of the Rand in April totaled 717,000 oz. For the first four months of the current year the total is 2,786,000 oz., against 3,032,000 oz. in this period of 1917. Floods in February reduced the yield considerably.

COPPER CARBONATE is in active demand at 30c. per pound.

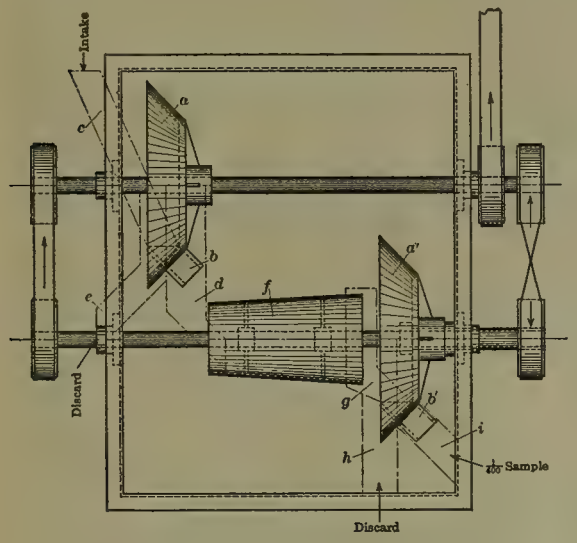
A Small Mechanical Sampler

*Although the device to be described was used in the sampling of carnotite ore, it may be of service in a laboratory or mine-sampling plant. The ore is reduced to pass through a 10-mesh screen placed at an angle of 45°, giving the following product:

Mesh	%	Mesh	%
On 14	2.0	" 65	11.2
" 20	9.4	" 100	5.4
" 28	15.0	" 150	2.0
" 35	34.5	" 200	0.6
" 48	19.0	Through 200	0.9
			100.0

All dust collected passes through a 200-mesh screen.

The ground material was easy to sample. This device was so arranged that one four-hundredth of the entire weight of ore treated was cut and collected as a representative sample. This sample was mixed with an equal



SMALL MIXING AND SAMPLING APPARATUS

proportion of the dust collected, quartered, split, and a final sample taken.

The mechanical sampling apparatus consists of two Snyder samplers with a mixer between. These samplers were cast-iron pans 16 in. diameter with flaring sides, set edgewise on a horizontal revolving shaft. A spout projecting through the flaring side of the pan passed under the feed-spout at each revolution of the machine and cut and delivered a sample.

As shown in the figure, the operation is as follows: Spout *b*, projecting through the flaring side of pan *a*, passes at each revolution under feed-spout *c*, and delivers a sample into the spout *d* of the revolving mixer *f*. During the remainder of the revolution of the pan *a*, the stream of ore from feed-pipe *c* is diverted as reject into spout *e*. The cut sample from the first pan passes through spout *d* into the mixer *f*, and the mixed material discharges therefrom into feed-spout *g*. The stream of the sample passing from spout *g* is again cut by the projecting spout b^1 of the second pan a^1 at each revolution, the cut sample passing into spout *i*, which is connected with the sample-bin below. The stream of ore during the remaining part of each revolution is diverted by the flaring side of pan a^1, and is delivered as reject through pipe *h*, into the ore-bin below. Pipes *e* and *h* are connected with the same ore-bin.

The entire sampling machine is enclosed in a dust-proof box made of galvanized iron 28 by 20 in. by 45 in. high. One side of the housing could be removed for inspection of the machine; the other contains a door. The removable side is packed with felt, and the door is fastened to the box by means of hand-screws.

The opening of the spout in the pan is 1¾ in. One-twentieth of the entire quantity treated is cut by the first pan, the second pan also cut 1/20 of the sample, the final sample obtained being 1/400 of the total ore passing through the machine.

*Abstract from Bull. 103, Mineral Technology 11, U. S. Bureau of Mines, 1917.

NEW METHOD OF BURNING POWDERED COAL. Run of mine or slack coal is crushed to 1¼ in. or smaller and dumped on a conveyor belt which carries it to magnetic separators to remove tramp iron, and then to a 700-ton steel storage bin. From this the coal is admitted to a 10-ton per hour rotary drier, which reduces the moisture content to about 1%. The dried coal is crushed and pulverized to 95% through 100 mesh and 85% through 200 mesh, the fine dust being carried from the air-separation mills to an 8-ton storage bin, from which it is drawn into two 5-ton blowing-tanks. The operator, on signal, admits compressed air above the coal in the blowing-tanks, and from the floor a valve to a 4-in. transport pipe opens through which the coal is delivered. A weighing dial regulates the amount passed. Each transport pipe starts from a point near the tank bottom and passes out near the top. The coal moves along the transport pipe to bins at the furnaces where required. Controllers are attached to the bottom of the hopper at the furnace-bin to regulate the exact feed to each burner. The burners are cast-iron pipes with specially shaped elbows. The air for combustion enters the elbow under a pressure of 1¼ oz., and the compressed air conducting the powdered coal under a pressure of 6 oz. expands down to 1¼ oz. and mixes with the combustion air. The control of the coal-feed permits the use of any flame desired, either oxidizing or reducing. The burners are used in 70-ft. slab-furnaces and for billet-heating furnaces. The steel as it comes from the furnace is said to be 'softer' than that treated in natural-gas fired furnaces, and the absence of an excess of air reduces the formation of scale to a minimum. The furnace temperature is regulated by the amount of coal passed to the burner, and by the quantity of air admitted. Air-firing at 1¼ oz. reduces the abrasive action on the brickwork of the furnace.—'Iron Age.'

CLAY IMPORTS into the United States last year amounted to 293,678 tons, valued at $1,647,525. In 1916 the totals were 317,465 tons and $1,645,850.

Splicing Wire Rope

*Wire rope is susceptible of perfect splicing. A smoother and better splice can be made in this than in manila rope.

Splices for running rope are all known as the long splice, and should be put in from 20 to 50 ft., depending upon size of rope and condition of work. The diameter of the rope is not altered, nor the strength of the rope perceptibly weakened. The accompanying sketches explain splicing in all its stages, and by a little study of them and carefully following the directions any ordinary man can make a successful wire-rope splice. The directions given are for making a 30-ft. splice. When a longer or shorter splice is required, proportionate figures will apply.

In most cases the rope can be applied endless. Where the endless rope cannot be put on, the rope must be placed around the sheaves, drawn tight with tackle-blocks, and the splices made on the spot as in Fig. 1.

The following tools are required: A hammer and a sharp cold-chisel for cutting off ends of strands, a steel point or marlinspike for opening strands, two pieces of heavy tarred marline or thin rope with sticks (Fig. 5) for untwisting rope, a pocket-knife for cutting the hemp core, and a pair of two-pound copper mallets.

(1) Place the rope around the sheaves and draw it taut with a pair of tackle-blocks (Fig. 1). The blocks should be hitched far enough apart to give room between to make a 30-ft. splice. A small clamp may be used to prevent the lashing from slipping on the ropes where the blocks are hitched. See that the hopes overlap about 30 ft., about 15 ft. each way from the centre. Then mark the centre of both ropes with a piece of chalk, or by tying on a small string. Proceed to splice, with the blocks remaining taut when it is necessary, but a better way is to remove the blocks, throw off the rope from the sheaves, let it hang loose on the shaft, and then proceed with the splices on the ground or floor, or scaffold, as the case may be.

(2) Unlay the strand of both ends of the rope for a distance of 15 ft. each, or to the centre strand of both ends of the rope for a distance of 15 ft. each, or to the centre mark. Cut off the hemp cores close up, as shown in Fig. 2, and bring the bunches of strands together so that the opposite strands will interlock regularly with each other. (Fig. 3).

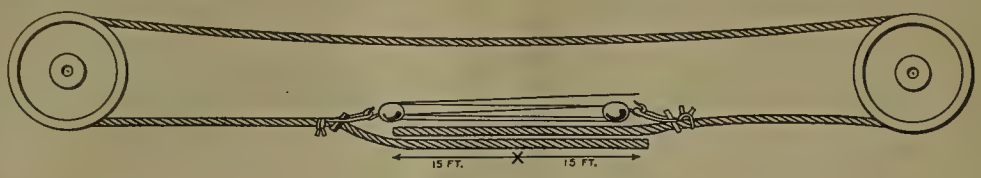


FIG. 1

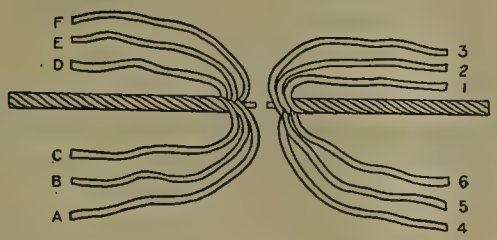


FIG. 2

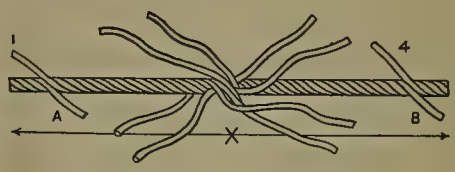


FIG. 3

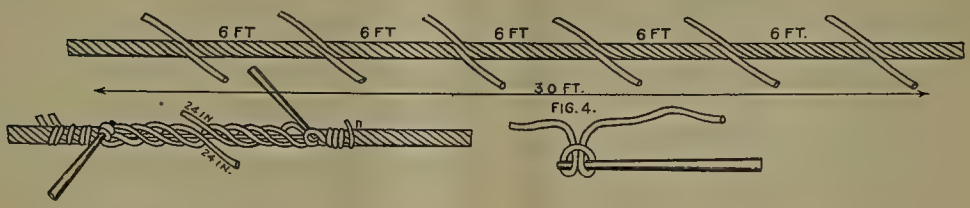


FIG. 5

FIG. 4.

FIG. 6

(3) Unlay any strand A, and follow up with one strand of the other end, laying it tightly in the open groove made by unwinding A; make the twist of the strand agree exactly with the twist of the open groove. Proceed with this until all but 24 in. of one are laid in. Cut off A, leaving an end about 24 in. long.

(4) Unlay strand 4 of the opposite end and follow with strand D, laying it in the open groove as before, and treating this precisely as in the first case (Fig. 2). Do the same with B and 2, stopping 6 ft. short of the first set. Next, with 5 and E, stopping as before, then with C and 3; and lastly with 6 and F. The strands are now all laid in with ends 6 ft. apart, as shown in Fig. 4.

(5) The ends must now be secured without enlarging

*Abstract from 'Leschens Hercules,' March 1918.

the diameter of the rope. Take two rope clamps (Fig. 5), and fasten them to the rope, as shown in Fig. 6; twist them in opposite directions, thus opening the lay of rope.

Next, with a knife cut out the hemp core for the necessary distance. Now straighten the ends and drive the marlinespike under the strands (Fig. 6), and work the end into the space previously occupied by the hemp core; then twist the clamps back, closing up the rope. The ends should be laid in, side by side—that is, they should not be crossed over each other. At the point where a tuck is made, hammer with copper mallets to fix the strands firmly in place. Next, shift the clamps and repeat the operation at the other five places, and the splice is made. In splicing rope that is to run over small sheaves or which is to be subjected to excessive strains, wrap the end of each strand for the distance that is to be tucked into the centre of the rope with tarred marline or electrician's tape, which will increase friction and prevent the ends from working out.

If the rope becomes slack, in time, and runs too loose, a piece can be cut out and the rope tightened up. This will require a piece of rope about 60 ft. long and two splices, one splice to put on the piece of rope, the other splice to join the two ends together.

The patent flattened-strand splice is no more difficult and is equally as effective as in the round-strand cable. The method of making this splice is identical up to the point of tucking in the ends of the strands. A slightly different treatment is required in this operation, due to the ratio in the size between the strands and the hemp core. The strand ends (see paragraph preceding directions) should be from 24 to 60 in. long, according to the diameter of the rope. Straighten out the ends of the strands by eliminating as much of the spiral form as possible. The entire length of each strand end is then wrapped with insulating tape, tarred marline or strips of burlap, until its diameter is slightly in excess of that of the hemp core. The tuck is then made similar to that of the round strand splice.

In styles A and C it is necessary to turn the strand sideways at point where it passes to centre of cable, thereby preventing a bulge in the cable. In cases of ropes having five strands, the odd tuck is made at the centre of the splice.

HYDRATION of the separate constituents of portland cement clinker has recently been subjected to investigation by G. A. Rankin, of the Geophysical Laboratory at Washington. From this study it is seen that the initial set in portland cement is probably due to the hydration of tricalcic aluminate; that the hardness and cohesive strength at first are due to the cementing action of the amorphous material produced by the aluminate and of tricalcic silicate; and that the gradual increase in strength is due to further hydration of these two compounds, together with the hydration of dicalcic silicate. The value of portland cement depends upon the fact that when finely powdered and mixed with water an amorphous gelatinous-like material is formed on the individual grains, cementing them together. The amorphous material results from the major constituents, tricalcic silicate, dicalcic silicate, and tricalcic aluminate. Of these constituents, the compound tricalcic silicate, which makes up about 30 to 35% of an average normal portland cement, is the one which hardens and develops the greatest strength within a reasonable time. This is due to the gelatinous hydrated silica which is readily released when this compound, in finely powdered state, is mixed with water. The essential process for the manufacture of portland cement is the formation of this compound. Unfortunately, the increase of the percentage of the tricalcic silicate does not appear economically possible at present. A more feasible plan of attack for improving cements would appear to be to release hydrous silica for some compound such as dicalcic silicate, which contains a higher percentage of silica than tricalcic silicate, by the dissolving action of some suitable electrolyte. Investigation along these lines may result in the discovery of a cement which will enable one to prepare a concrete closely approaching the ideal, that is, grains of sand cemented together with hydrous silicate, the toughest of sandstones.

CONSUMPTION OF CHEMICALS AT THE HOLLINGER MINE. During 1917 the 2500-ton mill treated 508,139 tons of $8.67 ore and 6162 tons of old concentrate assaying $7.71 per ton. Extraction was 95.16%, with a consumption as follows:

Material	Pounds per ton
Cyanide	0.448
Lead acetate	0.331
Lime	2.257
Zinc	0.360

The cost of treatment was $1:017 per ton. Stamp-duty was 15.4 tons per day. Pregnant solution precipitated averaging $4.038 per ton amounted to 2.15 tons per ton of ore treated.

DIVIDENDS FROM THE BIG FOUR. Annual rate of distribution of these companies is now $8 by Chino, $4 by Nevada, $4 by Ray, and $14 by Utah, according to the 'Boston News Bureau,' but the outlook is uncertain for the future, on account of increased costs and taxes. The following tabulation shows dividend disbursements by these companies:

	Chino	Nevada	Ray	Utah
1917	$8,612,802	$8,297,747	$6,624,152	$23,555,105
1916	7,177,335	7,497,963	4,337,935	19,493,880
1915	2,609,860	2,999,185	1,872,319	6,904,083
Three years total	$18,399,997	$18,794,895	$12,834,406	$49,953,068
Total to date	27,488,132	35,771,869	15,555,252	75,770,882

INCREASES made in the production of by-product coke are shown by the fact that the output for the week ended March 30, 1918, amounted to 474,610 tons, being at the rate of 24,680,000 tons per year, whereas in 1914 the total by-product coke made in the United States was 11,219,943 tons. The present rate of production exceeds the total of bee-hive coke in 1914.



NEW YORK

Iron-Ore Resources of the World Discussed by A. I. M. E.—Silver Used in Photography.

The annual meeting of the New York Section of the A. I. M. E. was held at the Machinery Club on May 23, when several well-known authorities spoke on the iron-ore resources of various parts of the world. H. Foster Bain, assistant-director of the U. S. Bureau of Mines, stated that China's resources had been over-estimated; and that, in one instance at least, other minerals had been mistaken for iron ore. He gave a total of 400,000,000 tons available and suitable for modern furnace reduction, and an additional 300,000,000 tons that might be treated by native methods. The deposits are gradually passing under the control of the Chinese government, which has now seen the advisability of modifying the old law that owners of land are also owners of any minerals that may be found underneath. All the iron-ore deposits are controlled by Chinese or Japanese interests; and in this connection Mr. Bain made some interesting comments anent the expansive policy of the Japanese as a nation. In comparing the two principal Asiatic races, China and Japan, it was pointed out that, formerly, agriculture was of primary importance; but that the growth of Japan has led to a change in the national character of industry. This development must inevitably force agriculture to a position of secondary importance, and is due to the fact that, whereas population is increasing, there is insufficient expanse of territory to maintain agriculture as the principal industry of the State. Japan's policy of expansion is therefore logical. The apparent lack of importance attached by China to her mineral resources is explained by the fact that she is still, and is likely to remain for some time, a country where agriculture is the predominant national industry. The Han-Yeh-Ping Iron & Coal Co. is the chief operator in China. Its mines are at Tayeh.

The iron-ore deposits of the north coast of Cuba were dealt with by C. M. Weld, who gave an estimate of over 3,000,000,000 tons available, a figure that has been checked by precise methods of computation. The iron content has been estimated at 40 to 50%, nickel 0.5 to 1%, chromium 1½%, silica 2 to 6%, phosphorus low, and sulphur negligible. The Bethlehem Steel Corporation owns a deposit estimated to contain 1,170,000,000 tons, underneath a surface area of 78,500 acres. The Midvale Steel Co.'s deposits amount to 300,000,000 tons; and the U. S. Steel Corporation's, 210,000,000 tons. The total deposits include a large proportion of soft ore, estimated to contain a billion tons of metallic iron. The water content of the average ore is a noteworthy feature, analysis showing 25% of hydroscopic and 13% of combined water. Nodulizing is necessary in order to reduce subsequent expense, and the product from the sintering-machines can be dressed to 55% iron, and of a character so that 90% will be retained on a 10-mesh screen. This nodulized ore can be placed at Atlanta at a total cost of $2.50 per ton. The smelting of this product has been highly successful, with a fuel ratio of 1 to 1. The pig-iron produced is especially useful for making satisfactory spiegel, high in combined carbon and low in the graphitic variety. When mixed with other iron it is suitable for ordinary casting work; and is also largely used in steel-making.

An interesting account of the Scandinavian deposits was given by Waldemar Lindgren. The southern Swedish reserves were stated to be small and insufficient for export. The central Swedish deposits were given as 122,000,000 tons. The Lapland reserves have been estimated to contain 1,150,000,000 metric tons of 58% iron, with 1½ to 3% of phosphorus as apatite. All the ores in this region contain apatite. Of the total Swedish production of from 6,000,000 to 7,000,000 tons annually, previous to the War one-third of this went to England and the remainder to Germany. It is probable that practically all the production now goes to the latter. Open-cut operations have been changed during recent times to underground methods on account of the severity of the climate. The northern part of Norway contains three important deposits of magnetite, estimated to contain 100,000,000 tons. Concentrating-plants are to be erected, the high-grade ore will be mined, and the normal low-grade ore obtained by open-cut methods. Other important deposits in Sweden contain 150,000,000 tons with an average iron content, in the form of hematite, of 35%. The mineral is flaky, and experiments are being made to determine the best method of dressing.

The iron-ore resources of Brazil were dealt with by E. C. Harder, who mentioned an estimate of 3,500,000,000 tons. The ore is hard and contains an average of 65% iron, less than 0.2% phosphorus, and a little silica. The deposits are, comparatively speaking, inaccessible; and there is no coal locally available. Bonuses offered by the Brazilian government to encourage the iron industry have not been taken advantage of to any extent. The deposits, for the most part, are in the hands of English and American concerns, with France and Germany interested to a smaller extent.

The resources of southern Europe and northern Africa were described by A. C. Spencer, who prefaced his remarks by the exhibition of charts showing the production and manufacture of iron by the various warring nations. In this connection it was interesting to note that in 1911, Germany's production of iron, a large proportion of which was from imported ore, exceeded the total output of the Allies during the year. Estimates of France's ore-reserves are difficult to obtain, but have been estimated at 3,300,000,000 tons, of which 3,000,000,000 tons is in Lorrain. The available reserves in Spain and Portugal have been estimated at 730,000,000 tons. A large proportion of Spain's output, consisting of about 33,000,000 tons annually, goes to Great Britain, and is used in the bessemer steel industry. Ore-reserves of Austria-Hungary have been estimated at from 200,000,000 to 300,000,000 tons. Greece has 100,000,000 tons of nickeliferous ore, similar to the Cuban deposits; and Mr. Spencer stated that Cuban methods of treatment were being modeled on Grecian practice. Italy's ore-reserves are negligible. Algeria and Tunis have from 100,000,000 to 150,000,000 tons of 50% bessemer-grade ore available.

The annual report of the Eastman Kodak Co., in which a net profit of $14,542,657 for the year is recorded, draws attention to an industry which absorbs a large quantity of silver. The white metal used in the manufacture of plates, films, and papers, is practically unrecoverable; so that con-

sumption from this source must be placed in a different category from that which goes into circulation as coinage, or is made into ornaments or plate. The Kodak company uses between three and four million ounces of silver per year at its works at Rochester, N. Y., together with a small amount of gold and platinum.

DENVER, COLORADO

Re-opening Old Mines.—Oil-Shale and Lignite.

After several years of quiet in Colorado metal-mining conditions are rapidly changing for the better. The improvement seems to rest both in the resumption of activities in old districts and old mines and in new branches of mining, that is, new for this State. Space forbids enumerating the old mines undergoing rehabilitation; they are scattered throughout every mining county. One gets news of interesting work in centres that have been almost forgotten for a decade or more.

The Rawley mine, almost on top of the continental divide, is being equipped with an aerial tram to convey its ore 8 miles to its mill at Shirley. In northern Gilpin county, early production is anticipated from the long-abandoned but once famous Perigo and Gold Dirt mines. These, together with the War Eagle, have been acquired by Kentucky interests, and will be re-opened immediately. Operating as the Perigo Gold Co., the new owners have ordered radical improvements in two mills, including the use of the Ruth flotation process for gold-bearing sulphides. In the future, communication with these mines will be chiefly by way of Rollinsville, a station on the Denver & Salt Lake Railroad, instead of through Black Hawk as in early years.

A famous property at Ouray known as the Mineral Farm (because it appeared to early prospectors as 40 acres of richly-mineralized ground) is again attracting attention. Recent work disclosed another great ore-shoot. This property was located in 1875, and had its own smelter within two years. The country rock is quartzite. Some shoots have been remarkably rich in silver, others in copper.

Although much has been published in the press and in U. S. government bulletins regarding one new basis for mining in Colorado, little is told about the progress being made by the men and companies who are in the oil-shale business. Keen interest is manifested in this industry. Denver is constantly visited by men and women from almost every State looking into the chances of securing desirable oil-shale land, and investigating new processes for its treatment. The demonstration of a commercial-size unit of the Galloupe process brought together representatives of many new or proposed oil-shale companies. The Mt. Blaine Oil Shale Co., composed of shareholders and officials in the Tomboy Gold Mining Co. of Telluride, has purchased two Galloupe units of an estimated daily capacity of 50 tons each, and it was a test of one of these units that was open to the public at the Rex Iron Works. Results gave satisfaction to all concerned. This process not only distills the hydro-carbons generated from the shale but it delivers as many as 23 fractions thereof, besides saving ammonia, all in one operation. W. B. Van Atta is president and Hans A. Hansen is manager for the Mt. Blaine company, whose property is near DeBeque, Colorado. It is not now thought by those interested in this industry that any early legislation at Washington relating to the leasing of mineral lands will apply to oil-shale.

Lignite, occurring abundantly near Denver, disintegrates easily and often takes fire spontaneously when in dumps. Believing it to be to the interest of the country at large, W. J. Galligan, Federal Coal Commissioner for Colorado, requests residents of eastern Colorado not to lay in stocks of the better grades of coal for next winter, but to rely upon lignite that will be mined as required. This same request is being made in western Kansas and Nebraska with the object of reducing to a minimum any possible fuel famine. The operation of Colorado lignite mines has always been a difficult problem, owing to extremes in market demand with the shifting seasons.

The Denver Fire Clay Co., one of Denver's prominent business institutions for the past 42 years, has been reorganized, ownership reverting to heirs of Mr. Bosworth, the founder. Willis W. Case, retiring president, enters the brokerage business in Denver and is succeeded by Harold O. Bosworth. J. Claire Evans, recently manager of the technical supply department of Mine & Smelter Supply Co., is vice-president of the Fire Clay company and will be active in its administration.

MEDFORD, OREGON

Manganese Possibilities of Jackson County.

The director of the Oregon State Bureau of Mines, H. M. Parks, at the request of the Federal government, has made an examination of the manganese deposits in the Lake Creek district in the east end of Jackson county. His report is favorable. He says: "If this low-grade manganese ore is distributed throughout the entire depth of the tuff, they will soon have demonstrated a very large tonnage of ore. In fact, if this be the case, it can be demonstrated



SOUTH-WESTERN OREGON

within a few weeks that ore sufficient to supply the entire needs of the Government will be available, providing proper equipment is installed of sufficient capacity." The report states that the Manganese Metal Co.'s property is 17 miles south-east of the railroad at Eagle Point, connecting with the Southern Pacific near Medford. It is five miles south-east of Lake Creek, near the confluence of Lost creek with the south fork of Little Butte creek. The ore is a psilomelane and pyrolusite disseminated through a flat bed of volcanic tuff breccia. The thickness of this bed of tuff near where development is under way has not been fully determined, but will probably exceed 100 ft. The bottom of this tuff bed outcrops 400 ft. above Lost creek at an altitude of 2400 ft. All the open-cuts sampled assay from 2.13 to 14.86% Mn, the lowest coming from shallow openings. A 12-ft. vertical channel sample taken from a face of the open-cut, beginning 6 ft. below the surface, contained 14.86% manganese. Development so far indicates that the manganese contents improve materially 8 or 10 ft. below the surface. The volcanic tuff-bed in which the ore is found lies between flows of basalt, the overlying rocks of the hills have been largely removed by erosion. It seems that the ore will be found to be the product of weathering and rock decay of the overlying rocks, and that they were concentrated in these porous tuff-beds, largely, if not en-

tirely by the action of descending surface waters. The Manganese Metal Co. last winter built an experimental mill 150 ft. below a large open-pit on the west side of the hill. It consisted of a gyratory crusher of 550 tons capacity, two sets of rolls, and two Faust jigs. There is also a Faust table which has not been operated owing to lack of proper adjustment. Some details of the plant are not well arranged, and on this account they are operated under difficulties. Under these conditions there was produced recently 200 tons of 50% concentrate, containing 10 to 14% silica.

LEADVILLE, COLORADO

Drainage of Yak Mines.—Twin Lakes-Lackawanna District.

The Yak company is experiencing considerable difficulty in keeping the lower workings in the Cord and White Cap drained. The closing down of the Colonel Sellers over a year ago, and the abandoning of the Moyer by the Iron Silver company, last year, has thrown the entire burden of pumping upon the Yak. The Cord pumps are now handling 1200 gal. per min., and it may be necessary to put in additional equipment. Several new lessees are operating at the Cord with generally good results. The Yak is producing a normal quantity of ore, and with an increase in the price for pyrite will become one of the heaviest shippers of this material.

The Twin Lakes-Lackawanna district is alive with the spring rush of development, which promises to be the beginning of a number of important undertakings. G. W. Buehler of Brooklyn, New York, president of the Miller Gold Mining & Milling Co., has entered the district, and is now engaged in bringing supplies and materials to his property in Lackawanna gulch. Just before last winter caused operations to be suspended, the Miller was the scene of a rich gold discovery, the greatest that has been made in that part since the Mt. Champion mine was found. The vein cut at the Miller is 2 ft. thick, and varies from $50 to $150 per ton. Preparations are being made to undertake work on a large scale including opening the vein for several hundred feet in either direction. The property is equipped with modern machinery, has its own power-plant, and a saw-mill. Mrs. Mabel Miller of Twin Lakes has been the active manager of the property for two years.

GOLDEN, BRITISH COLUMBIA

Mining in North-East Kootenay, Embracing the Golden and Windemere Mining Districts.

During the past season (ended early in March) the Paradise mine shipped 2400 tons to Trail. The ore is known as 'sand carbonates,' and is almost self-fluxing. It averaged 50 oz. silver and 50% lead. Total shipments were 185 carloads. Regular shipments will commence at an early date. New development this year will be the continuation of No. 4 adit another 200 ft. at least.

The Sitting Bull Mining Co. did considerable development in 1917 and 1918. A light aerial tramway was erected. The ore is fine-grained galena and will average 46 oz. silver and 45% lead. Openings consist of several adits and shafts. The owners this season intend to construct a wagon-road from the head of Boulder creek to junction of the Horse Thief road, west of Wilmer. They will put in a compressor, etc., and drive a long adit. On completion of road shipments will be made.

The Delos copper claims are being worked by F. W. Wonn, of Seattle, representing Eastern United States capital. Buildings are under construction and development is progressing.

Considerable work was done on the Isaac property in the 1917-'18 season. Last year 4 cars were shipped, and in 1918 an equal number was taken out for shipment, but only one hauled to rail at Brisco. Ore is an argentiferous galena.

The Lead Queen has been worked steadily since 1916. Shipments were made in that year and last, but none this past winter, although some was taken out during development. This and the adjoining group (Steele) have possibilities as silver-lead producers. About 800 ft. of tunneling has been done on the Lead Queen, also surface work, and about 400 ft. on the Steele.

A 20-ton trial shipment was taken out last fall from the Mabel R. Ore carries 8 to 15 oz. silver and 80% lead.

This district has two promising low-grade lead-silver properties in the Giant at Spillimachene, and the Lead Mountain opposite Harrogate. Both are close to rail. It is not unlikely that they will be actively worked this year.

TORONTO, ONTARIO

Labor and Assessment Work.—Kirkland Lake and Boston Creek Notes.

The difficulty of procuring an adequate supply of labor, which has been severely felt by the mining industry of northern Ontario, has been rendered more acute by a recent amendment to the Military Service regulations, rendering aliens liable to be drafted. This will have the effect of considerably reducing many of the mining staffs, especially at Porcupine, where the proportion of aliens employed is larger than in most of the other districts. Porcupine is at a disadvantage as regards labor when compared with Cobalt and Kirkland Lake. At Cobalt, wages have been repeatedly raised automatically, being based on the price of silver, while at Kirkland Lake, companies are better able to pay higher wages than those at Porcupine, owing to the higher grade of ore. There will probably be a further curtailment of gold production at Porcupine, with a closing down of some of the smaller and low-grade mines. The Vipond-North Thompson and Schumacher mines are preparing to suspend work, being unable to compete with the larger mines in the labor market.

A recent order of the Ontario Department of Mines to the effect that claimholders who took advantage of the permission granted last year to postpone their assessment work until this year must make up their arrears, in addition to doing this year's work, created much dissatisfaction among mining men. It was urged that to compel them to do two years' work in one season would entail great hardship and loss. The Hon. G. H. Ferguson, Minister of Mines, after a personal visit of the mining districts, has modified his decision. While no general postponement of work will be granted, it is provided that in cases where two seasons' work is due, only one installment need be performed this year, the second being held over for a year. This will ensure development of claims without the imposition of too heavy a burden at a time when there are great difficulties in securing labor.

Kirkland Lake.—The Lake Shore is now the third largest gold producer in Canada. Starting at full capacity on March 8, the mill during March and April treated 2570 tons of ore; yielding bullion worth $66,696. The mill ran 97.21% of the possible time. The ore during April averaged $27.70 per ton.

At the Kirkland Lake mine the work of erecting the mill has begun. It will be the largest plant here, with a capacity of 150 tons daily. Ore reserves are valued at $750,000.

Boston Creek.—The new 50-ton mill of the Patricia is ready for operation. The property has been developed to the 200-ft. level.

At the Miller Independence a new shaft has been started and is down on a vein showing gold across a width of 12 ft., quartz stringers in basalt.

The new 200-ton flotation plant for dressing old sand and slime has been started at the McKinley-Darragh.

A small quantity of 1000-oz. ore has been shipped from the old Keeley mine at South Lorrain. Preparations are being made to commence extensive mining operations.

THE MINING SUMMARY

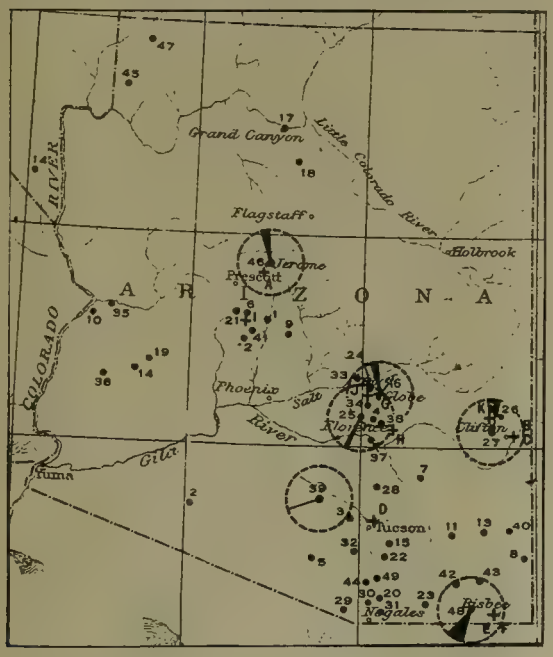
ALASKA

Anchorage.—Railroad construction is practically assured for the coming season, as the sub-committee of the House Appropriations Committee at Washington has recommended additional funds.

ARIZONA

Ajo.—The Bullion Bar Mining & Development Co., in the Gunsight district, 24 miles east of Ajo, has developed a promising gold vein, and is to erect a 10-stamp mill.

Bisbee.—Copper production of this State in May amounted to 76,711,507 lb. The largest contributors were



MAP SHOWING COPPER DISTRICTS OF ARIZONA

Phelps-Dodge with 17,749,000 lb.; Inspiration, 10,650,000 lb.; Ray Con., 8,100,000 lb.; United Verde, 6,575,000 lb.; Miami, 5,100,000 lb.; Calumet & Arizona, 4,800,000 lb.; Arizona Copper, 4,130,000 lb.; United Verde Extension, 4,100,000 lb.; New Cornelia, 3,900,000 lb.; and Consolidated Arizona, 2,000,000 pounds.

Calumet & Arizona paid $2 per share on June 14, making $4 for the current year.

Clifton.—The U. S. Bureau of Mines rescue-car that had been here for two weeks has gone to Kingman. Examinations of large classes were held at Clifton, Morenci, and Metcalf, 59 passing at Clifton.

Jerome.—Fire on June 6 destroyed property valued at $200,000 in part of the town of Jerome.

The Verde Combination shaft is down 1000 ft. in schist carrying iron pyrite and chalcopyrite. Another 100 ft. will be sunk.

To prospect the mineralized zone exposed by drilling in the Jerome Verde, a drift has been started, to be 420 ft. long.

Calumet & Jerome is to be prospected by diamond-drilling. A contract will be let for 5000 ft. of holes from the 600-ft. level, into the pyritic schist-zone.

Green Monster, Gadsden, Pittsburgh-Jerome, Jerome Superior, Shea Copper, Grand Island, Hayden Development, Dundee-Arizona, Verde Squaw, and Squaw Peak are all actively searching for ore.

Superior.—Water in the workings of the Silver King is now below the 400-ft. level. A shipment of high-grade ore was made to the smelter last week, and it is believed that shipping will continue at the rate of two cars per month.

Grand Pacific is hauling ore for shipment; a considerable quantity having accumulated. A raise has been completed, and a tram is now being constructed from the third level to the ore-bins. The 1900-ft. adit is to be continued another 200 ft., and another 700-ft. diamond-drill hole put down.

Wickenburg.—The Abe Lincoln Copper Co., in Black Rock district, recently installed a 60-hp. Western gasoline engine and hoist, and a 60-hp. Chicago Pneumatic compressor using three jackhamer drills. Development on 5-ft. vein is to the extent of a 1000-ft. tunnel and 400-ft. shaft. Ore carries 10 oz. silver and 11% copper. Charles E. Nathorst, late assistant superintendent of the United Verde, is manager.

ARKANSAS

Fort Smith.—The Fort Smith Spelter Co., which suspended smelting recently owing to an accumulation of slab zinc, has resumed operations.

CALIFORNIA

Grass Valley.—Between its mill and Pennsylvania mine, about a mile apart, the Empire company is constructing an electric tramline, so as to be able to treat all ore at its 60-stamp mill. Work at 2800 ft. in the Empire mine has exposed a good deal of ore.

Brunswick Consolidated is working at reduced capacity on account of unsatisfactory conditions.

Ingot.—The Afterthought Copper Co.'s mine, roasting and oil-flotation plant were closed and 100 men laid off on June 3. The reasons given by the management are that the Government's increase of freight rates by 25%, effective June 10, makes its impossible to ship profitably the heavy concentrates to zinc smelter in Oklahoma and copper smelter at Tacoma. The output of the mine was heavier last month than ever before under the company's management, and the ore was higher in copper. It is reported, but not officially, that the company will erect an electrolytic plant.

San Francisco.—The State Mining Bureau has just completed compilation of the quantities of oil and gas produced during 1917. The figures are based on sworn statements from all producers. The output was 94,433,547 bbl., an increase of 7,370,352 bbl. The official figures are less than the total published by private corporations. The latter, however, make no allowance for water and other impurities in the oil when first produced and gauged. Aside from this difference, it is worthy of note that the Standard

Oil Co. and the Independent Oil Producers' Agency have regularly supplied the public with accurate information. There were no additions of importance during 1917 to the proved oil-land area as determined by the State Mining Bureau for assessment of 1916. The new Montebello field production was the outstanding feature of the year. The increase in production, for which figures are given above, was brought about by marked drilling activity throughout the State. There was an increase in production in every petroleum-producing county. Los Angeles county showed the highest increase, namely 52% over last year's production. There were 984 wells reported to the State Mining Bureau, for drilling, during 1917. The rate of assessment, levied to support the work of supervision of drilling operations, so as to protect the field from damage by water, is based on the quantities of oil and gas produced and of proved oil land. The rate for the coming year amounts to $0.146 per acre of proved oil land and $0.00119 per barrel of oil or per 10,000 cu. ft. of gas. The total amount to be collected is $130,000.

The figures in detail are as follows:

County	Acres	Oil, bbl.	Gas, cu. ft.	Wells
Fresno	12,993	16,146,797	59,189,000	1131
Kern	56,947	52,688,711	1,927,506,000	4716
Los Angeles	2,401	4,357,162	24,175,000	748
Orange	3,418	14,568,930	655,027,000	467
Ventura	1,726	989,726	.....	355
Santa Barbara	9,023	5,589,223	60,157,000	385
San Louis Obispo	772	74,143	.....	18
Santa Clara	80	18,855	.....	14
Total	87,360	94,433,547	2,726,054,000	7834

COLORADO

Boulder.—Boston capital is said to have secured large holdings of tungsten claims at Nederland.

The Tungsten Products Co. is reported to have acquired the old Strahanan tungsten mine between Victor and Dry Lake.

The Colorado Metal Mining Association has formed an oil section to aid oil development in Boulder county.

Cripple Creek.—Cresson Consolidated paid 10c. per share, equal to $122,000, on June 10. This makes $6,295,163 to date.

Georgetown.—The Colorado Pay Rock Silver Mines Co. has been organized to operate the Pay Rock silver property in this district. The total production of the Pay Rock mine is estimated to have been $2,000,000. The mine is entirely above water-level, and has been worked from a series of tunnels, the highest being 1400 ft. higher than the lowest, which is known as the Ashby. The mouth of this is within the townsite of Silver Plume, and possibly 150 ft. above the level of Clear creek. This tunnel intersects the Pay Rock lode 1945 ft. from its portal.

Green Mountain.—Since electric power is again available, mines here have resumed normal work.——The Pride of the West Mining Co. has shipped five cars of rich lead ore during the past two weeks.——The Dives-Shenandoah, operated by the Dives Leasing Co. has commenced shipments of high-grade silver ore, about six cars having been dispatched during the past two weeks. These shipments by the largest producers signal the opening of the season for Green Mountain.

Nederland.—Mining men of this district have organized to co-operate with the Colorado Metal Mining Association.

Rico.—A strike prevails here, where the men have made demands for the same scale that is paid at Telluride. Production of ore is almost at a standstill, but indications are that the higher wage will be established. During the period from May 7 to 20, twenty cars of copper sulphide ore were shipped by the Rico Argentine.

Romley.—The report of G. E. Collins, general manager for the Mary Murphy Gold Mining Co., operating in the Chalk Creek district of Chaffee county, gives the following concerning operations in 1917:

The net operating loss was $73,943, plus $20,104 interest and depreciation, and $13,956 expenditure on the Red Mountain mines, a total loss of $108,002. Current assets amount to $229,961, and liabilities $120,200. Reserves total $128,583. Development at the Mary Murphy mine was extremely disappointing. Labor was markedly short. Mining costs increased 58%. In the Red Mountain district, 10,700 ft. elevation, between Ouray and Silverton, the Yankee Girl, Genesee-Vanderbilt, and Robinson mines were acquired from J. M. Hyde, payment to equal his outlay on them. These are old silver producers, opened below 1000 ft. Ore occurs in vertical chimneys, but the areas prospected are a small portion of the whole. Some shoots carry copper, others lead and zinc, both with silver and gold; while others carry all of these metals in a complex mixture. A good deal of low-grade ore is exposed, and chances in the Yankee Girl and Robinson for finding rich ore are good. At the Genesee a 50-ton mill is being built. Complex ore may be sent to the mill at Romley. These mines are wet, and the water acid and corrosive, but new tunnels have reduced this trouble. The Mary Murphy mill dressed 36,231 tons of ore, against 54,954 tons in 1916. The flotation department gave poor results. The pneumatic type of cell has been found the best. Concentrates shipped were 950 tons of iron, 756 tons of iron-copper, and 1754 tons of zinc, valued at $216,578. Tributors mined 1040 tons of ore worth about $25 per ton. Costs were $4.86 for mining, 18c. for aerial trams, $2.46 for milling, and 49c. for general, a total of $7.99. In 1916 this was $6.79; in 1915, $5.56; and in 1914, $5.38 per ton.

Telluride.—During April 113 cars of ore was shipped from Telluride, against 162 in March. The drop is due to curtailment of heavy shipments from the Liberty Bell, which is changing its milling system.

The Tomboy has continued normal shipments of iron concentrate. A fire, caused by an upset carbide lamp, destroyed the change-room at the Tomboy, entailing a loss of $5000, as the building was not covered by insurance.

The Caruthers lease mill is still closed on account of lack of power. A large amount of ore has been mined.

The roads to the various mines are opening much earlier than in former years. During the past season all-year traffic was possible to the Belmont-Wagner holdings for the first time in many years.

IDAHO

Mullan.—Consolidated Interstate-Callahan reports as follows for the first quarter of 1917:

Ore milled (21.02% Zn, 6.77% Pb, 2.27 oz. Ag), tons	35,881
Ore shipped (48.70% Zn), tons	1,457
Ore shipped (11.65% Zn, 43.19% Pb), tons	725
Concentrate shipped (44.48% Zn), tons	12,591
Concentrate shipped (16.27% Zn, 49.94% Pb), tons	1,579
Zinc contents, pounds	12,621,704
Lead contents, pounds	2,203,660
Zinc recovery, per cent	79.78
Cost of mining, per ton	$4.723
Cost of milling, per ton	1.982
Net value of shipments at destination	$461,744
Net profit, plus and minus miscellaneous amounts	138,087
Dividend	none

Costs show a decrease of 59.6c. per ton when compared with the previous period. On No. 8 level 360 ft. of driving was done in ore assaying 24% zinc and 8% lead. The shaft was sunk to No. 9 level, 200 ft. below No. 8. Ore is

being opened at the new level. The tailing dump of 250,000 tons carries 12% zinc, and is being dressed by flotation. A profit of $1,000,000. is expected from this reserve, calculating spelter at 7c. per pound.

Consolidated Interstate-Callahan will pay 50c. per share on June 15. This is equal to $232,495, making $6,742,-355 in three years.

MICHIGAN

Houghton.—It is possible that six or eight of the smaller mines in the Copper Country may be forced to suspend operations, being unable to work profitably with the present price of copper.

Isle Royale has five stamps crushing continuously, and a daily output of 4000 tons of ore is expected soon.

Pinex.—Although White Pine Extension, in Ontonagon county, has done sufficient work to warrant large scale operations, it has been found advisable to suspend until labor and financial conditions warrant resumption.

Recent dividends declared are as under:

Company	Amount per share	Date	Total for 1918
Ahmeek	$2.00	June 28	$6.00
Isle Royale	0.50	"	1.50
Osceola	2.00	"	6.00
Quincy	2.00	"	4.50

MISSOURI

Galena.—A market has been found for the pyrite mined in this district. The mineral is extracted from some old mines where it made mining for zinc impossible in the past. The ore carries 48% sulphur, and the Grasselli Chemical Co. is paying 26½c. per unit of a long ton, with penalties for zinc.

Joplin.—Production of the region last week was 5578 tons of blende, 48 tons of calamine, and 1259 tons of lead, averaging $49, $33, and $84 per ton, respectively. The total value was $381,876, making $10,319,752 for 22 weeks. Missouri contributed $68,669.

NEVADA

Goldfield.—The Goldfield Consolidated has arranged to treat ore for the Manhattan Consolidated of Manhattan; Red Hill Florence of Goldfield; Tonopah Divide of Gold Mountain district, and other outside properties. Part of the plant will continue to treat oxidized ore from the upper levels of the Consolidated. On account of difficulty in marketing flotation concentrates flotation has been considerably curtailed.

Nelson.—Spring has brought new life to the El Dorado district. Since the Techatticup company decided to do custom milling several small operators have started.

The Wall Street mine, a famous producer of the 'eighties, has been leased to J. C. Gilbert, who is working on the dump containing about 5000 tons of medium-grade ore.

The Crown Queen is also being worked by a night shift under Techatticup superintendence, and the ore sent to this company's mill.

The Colorado-Nevada mill is being overhauled. Work in the mine will be started shortly after.

The Rand mine is to use flotation, the first operator in the district to try it. A K. & K. machine will be installed, and the old tailing dump from the stamp-mill is to be treated.

The Germain lease on the Lombard claim is busy getting its new mill equipment into order.

Allured and Allured, at the Carnation, have discovered a promising vein running parallel to their present workings. More men are to be employed.

The M. & D. Mining Co., after cutting 26 ft. of copper ore in Copper canyon with an Okell core-drill, is sinking a vertical shaft to open it. The company is under Japanese management, and as this is the only copper prospect in the district operations are watched with interest.

Tonopah.—Production of the district last week totaled $174,743 in 10,279 tons of ore. Eight mines contributed.

In the apex suit between Jim Butler and West End, the U. S. Supreme Court at Washington on June 10 denied the claim brought by the Jim Butler to recover the value of ore extracted from beneath the surface of their claims by the West End. In bringing the suit the Jim Butler denied an apex existed, but contended the vein was in the form of a roll. The lower courts, in part, sustained this contention, but ruled that the crest of this roll constituted an apex, and that the West End had the right to operate the vein indefinitely in opposite directions on both sides of that point. While this suit was pending, silver and gold extracted from ore mined in the disputed ground was held in escrow, and amounts to nearly $400,000. This will be retained by the West End. Owing to an incorrect version of the decision being current in San Francisco, shares in these two companies fluctuated violently.

UTAH

The four smelters in this State—at Garfield, Midvale, Murray, and Tooele—are said to be treating normal quantities of ore and concentrate from this State and others in the West. The daily total is between 7000 and 8000 tons.

Alta.—The road to Alta is in good condition for hauling ore to rail. Several mines have considerable quantities ready, especially the Cardiff, South Hecla, and Extension.

Bingham.—Fire broke out again in the Utah-Apex mine on May 27, between the 1300 and 1400-ft. levels. It may be necessary to flood the mine again, as described on page 801 of the 'Press' of June 8.

Park City.—The Silver King Consolidated tunnel is in harder shale, and indications are that the limestone contact is near. The heading is in 6750 ft., advance being 15 ft. daily. The objective is 7000 ft. farther.

Watson.—The Crane Oil Shale Co. is to erect a 500-ton



MAP SHOWING OIL-SHALE AREAS OF COLORADO, UTAH, AND WYOMING
(From 'Met. & Chem. Eng.')

distilling plant near here. The shale is said to contain 75 to 85 gal. of oil per ton, 24 lb. of ammonium sulphate, and 31 lb. of paraffine wax. A. G. Crane has devised a process of recovery.

The Pioneer Oil Shale Co. is to erect a 200-ton distilling plant, using the process of L. B. Glafcke.

The Ute Oil Co. is to erect a 400-ton shale distillation plant near here. It will consist of 18 retorts. A 95% extraction of oil can be made in 55 minutes, according to recent tests. D. H. Gustaveson is consulting engineer.

NEW MEXICO

Mogollon.—The new 250-ton mill of Socorro M. & M. Co. is nearing completion. At the mine ore breaking and development is under way.

The Mogollon Mines Co. treated nearly 5000 tons in May. Improvements are being made at the mill.

Sinking has been resumed at the Central shaft of the Oaks Co. This will be put down to No. 4 level.

Silver City.—A bismuth deposit, assaying 3% metal, is reported as being opened in the southern part of Grant county by I. J. Stauber.

OKLAHOMA

Commerce.—The Triangle Mines Co.'s new 300-ton mill is ready. It contains oil engines, gyratory crushers, rolls, Isbell vanners, etc.

Picher.—The Oklahoma fields last week produced 4538 tons of blende and 971 tons of lead, valued at $313,207.

WASHINGTON

Northport.—Electric Point Mining Co. paid 3c. per share, equal to $23,790, on May 25. This makes a total of $190,320. The mine is in good condition down to the bottom, 800-ft. depth, and is producing a carload of ore daily. Construction of the Riblet aerial tram—2¼ miles long—is proceeding steadily.

CONSERVATION OF TECHNICAL MEN

It having become evident that the country is recklessly sacrificing its available supply of engineers, chemists, physicists, and other vitally needed technical men, and the fact being that the existing regulations are ineffective for conserving these men for rendering the duty which they alone do, the Engineering Council, created to provide means for united action and to speak authoritatively for its technical societies has passed the following resolutions:

"WHEREAS, technically trained engineers are indispensible to the Army, the Navy, and the War industries, in engineering corps, ordnance bureaus and signal corps, in aviation, submarine and tank service, in shipbuilding, and in many other assignments;

WHEREAS, through draft and otherwise many of these irreplaceable men have been and are being diverted, so that their special qualifications are not being utilized, be it

RESOLVED, that in the opinion of the Engineering Council technically trained men of all ages should be enrolled and conserved for technical duties, and special efforts should be made immediately by the War and Navy Departments to find and record such men among drafted and enlisted forces, and to assign them to places in which their special qualifications are needed; and be it further

RESOLVED, that the Engineering Council offers to assist the War and Navy Departments in locating and classifying such men, if its assistance be desired, provided these departments will give the necessary facilities for collecting information about engineers now in the Army and Navy, or whose names are upon the selective draft lists.

These resolutions are offered solely in a patriotic spirit of helpfulness,"

ALFRED D. FLINN, Secretary.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

W. J. Loring is in New York.

W. Tovote is at Venice, California.

E. H. Wedekind is in San Francisco.

R. Gilman Brown has been elected a vice-president of the Institution of Mining & Metallurgy, London.

F. W. Bradley is at Kellogg, Idaho, making a visit of inspection to the Bunker Hill mine and smelter.

George E. Collins came to San Francisco from Denver to attend the funeral of his brother, Edgar A. Collins.

E. S. Bardwell is to be in charge of the new ferro-manganese plant of the Anaconda Copper Mining Company.

J. W. Sherwin, of the West End Consolidated at Tonopah, is here.

H. H. Nicholson is examining cobalt deposits in eastern Oregon.

T. J. Anderson is returning to New York from La Grange, California.

Ben. B. Lawrence passed through San Francisco on his way from New York to Oregon.

Robert S. Lewis, Professor of Mining in the University of Utah, is at Huntington Lake, California.

George Purcell Costigan Jr. will deliver a course of lectures on mining law at Stanford University this summer.

L. G. E. Bignell has been appointed sales-manager to Sutton, Steele & Steele, concentrating engineers at Dallas, Texas.

W. H. Freeland has returned to San Rafael, California, from a visit of inspection to the Ducktown Copper Co. in Tennessee.

William Sampson, formerly at the Nickel Plate mine, at Hedley, B. C., is now with the Sunset Copper Co. at Index, Washington.

C. A. Duntley, son of W. O. Duntley, of the Duntley-Cotton Mines Co., operating in Calaveras county, California, is Lieutenant in the National Army.

J. W. Hutchinson, general manager of the Goldfield Consolidated and Aurora companies, has resigned and has gone to Washington to enter the Engineer Corps of the Army.

John C. Ralston, of Spokane, shared the $1000 prize offered by the National Security League for the best suggestion of a method to get American war aims before the people of Germany.

Milton E. Pinney, an early-day mine-operator in Colorado, and owner of the first stamp-mill erected in the Black Hills of South Dakota, died at Oakland, California, on June 2, at the age of 82 years.

The trustees of the United Engineering Society at New York have elected the following to the Engineering Foundation Board: **Calvert Townley, Silas H. Woodard, Joseph W. Richards, David S. Jacobus,** and **H. Hobart Porter.**

Alfred Stansfield, Canada's foremost authority on electrometallurgy, has accepted a commission from the British Columbian government to make a full investigation into the commercial possibilities of electric-smelting methods in the development of the iron-ore resources of the Province. Mr. Stansfield is professor of metallurgy in McGill University.

The Australian Chemical Institute has been formed, starting with a membership of 390 in all States.

The American Mining Congress has organized a chapter in Oklahoma, with headquarters at Oklahoma City.

THE METAL MARKET



METAL PRICES

San Francisco, June 11

Aluminum-dust, large and small lots, cents per lb.	65—70
Antimony (wholesale), cents per pound	15
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	7½— 8½
Platinum, Government price, per ounce	$105
Quicksilver, per flask of 75 lb	$110
Spelter, cents per pound	9¼
Zinc-dust, cents per pound	17½

ORE PRICES

June 11

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38% and over, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton (nominal price)	$7.00—$8.00
Manganese, domestic, 35 to 54%, f.o.b. South Chicago, per unit (Government price, effective May 29)	$0.86—$1.30
Manganese, domestic, 35 to 54%, f.o.b. east of South Chicago, per unit (Government price, effective May 29)	$1.01—$1.45
(Manganese, domestic, penalty of 50c. to $1 per ton for 8% and up to 25% silica, and bonus of 50c. to $1 for less than 8 and 5%.)	
Molybdenite, per lb., 90% MoS_2	$1.25
Pyrite, domestic, New York, cents per unit of sulphur	28
Tungsten, 60% WO_3, California, per unit	$24

For further details of manganese read the notes under that title on this page.

EASTERN METAL MARKET

(By wire from New York)

June 11.—Copper is unchanged. Lead is active and higher. Spelter is steady and stronger.

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to make prompt settlements with smelters and brokers, producers allow a discount from the Government price of $1, hence the lower price. The Government has not fixed the general market price at $1, but will pay this price (as from April 23, 1918) for all silver purchased by it. The equivalent of dollar silver (1000 fine) in British currency is 46 65 pence per ounce (925 fine), calculated at the current rate of exchange.

Date	New York, cents	London, pence
June 5	99.50	48.87
" 6	99.50	48.87
" 7	99.50	48.87
" 8	99.50	48.87
" 9 Sunday		
" 10	99.50	48.87
" 11	99.50	48.87

Average week ending

Apr. 30	99.66
May 7	99.52
" 14	99.50
" 21	99.50
" 28	99.50
June 4	99.50
" 11	99.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	67.86	87.38	....
May	74.27	74.61	99.50	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67½c. for small lots, effective until June 1, 1918. On this date the prices were re-fixed until August 15, 1918. Quotations in cents per pound are as under:

Date	
June 5	23.50
" 6	23.50
" 7	23.50
" 8	23.50
" 9 Sunday	
" 10	23.50
" 11	23.50

Average week ending

Apr. 30	23.50
May 7	23.50
" 14	23.50
" 21	23.50
" 28	23.50
June 4	23.50
" 11	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.63	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	23.50	Oct.	28.50	23.50	....
May	29.02	31.69	23.50	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. On May 25, 1918, the Government fixed prices until September for grade A spelter at 12c. per lb. for itself and the open market. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c., and plate at 14c. per pound.

Date	
June 5	7.50
" 6	7.50
" 7	7.50
" 8	7.62
" 9 Sunday	
" 10	7.62
" 11	7.62

Average week ending

Apr. 30	6.88
May 7	7.00
" 14	7.21
" 21	7.41
" 28	7.50
June 4	7.50
" 11	7.56

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	21.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	7.29	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date	
June 5	7.20
" 6	7.25
" 7	7.25
" 8	7.30
" 9 Sunday	
" 10	7.40
" 11	7.45

Average week ending

Apr. 30	6.85
May 7	6.72
" 14	6.73
" 21	6.92
" 28	7.07
June 4	7.16
" 11	7.31

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.01	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	6.88	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	8.10	....

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date	
May 14	110.00
" 21	110.00
May 28	110.00
June 4	110.00
" 11	110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	138.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115.00	Oct.	78.20	102.00	....
May	90.00	104.00	110.00	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	38.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	100.01	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Chinese tin is quoted at 84c. on the Pacific Coast.

MANGANESE

A schedule of prices for domestic ore has been arranged by the American Iron and Steel Institute, and approved by the War Industries Board, effective indefinitely after May 28. Prices are per unit of metallic manganese per long ton (2240 lb.), for ore mined and shipped from all points west of South Chicago, Illinois. The prices are on basis of delivery, f.o.b. cars South Chicago. When shipped to other destinations than Chicago, the freight-rate per gross ton from shipping point to South Chicago is to be deducted to give the price f.o.b. shipping point. For ore shipped from points east of Chicago, 15c. per unit is to be added to the schedule given below. Chemical ores are not included. Prices are based on ore dried at 212°F.

Mn, %	Per unit
35 to 35.99	$0.86
36 " 36.99	0 90
37 " 37.99	0.94
38 " 38.99	0.98
39 " 39.99	1.00
40 " 40.99	1.02
41 " 41.99	1.04
42 " 42.99	1.06
43 " 43.99	1.08
44 " 44.99	1.10
45 to 45.99	$1.12
46 " 46.99	1.14
47 " 47.99	1.16
48 " 48.99	1.18
49 " 49.99	1.20
50 " 50.99	1.22
51 " 51.99	1.24
52 " 52.99	1.26
53 " 53.99	1.28
54 and over	1.30

These prices are net to producer, buyers to pay salary or commission of their agents. In payment, 80% of estimated value of the ore (less moisture and freight from shipping point) to be paid against railroad bill-of-lading, with attached analysis, balance on receipt of ore by buyer.

The above prices are based on ore carrying not over 8% silica and 0.25% phosphorus. Bonuses and penalties are as under:

Bonuses: SiO_2, %	Per ton
Each 1% between 8 and 5%	$0.50
Each 1% under 5%	1.00

Penalties: SiO_2, %	Per ton
Each 1% from 8 to 15%	$0.50
Each 1% from 15 to 20%	0.75
Each 1% from 20 to 25%	1.00

For each 0.01% in excess of 0.25% there is a penalty against unit price paid for manganese of ½% per unit figured to fractions.

Eastern Metal Market

New York, June 5.

Strength has developed in some markets in the past week, but there has been no pronounced activity in any. The tone is mainly firm, the only decline having appeared in tin.

Tin transactions and offerings have been very light and the downward tendency in quotations continues.

Conditions are unchanged for copper, which continues in heavy demand at Government prices.

Lead is fairly active, firm, and steady, with an advancing tendency.

Zinc is quite firm at unchanged price levels.

Antimony is lifeless, but no lower.

In the steel industry there is still a scarcity of steel for Government needs, though these are not fully known. Some days may elapse before a balance can be struck between the definitely scheduled demand the Government will make upon the steel industry for the rest of the year and the country's newly ascertained capacity in the various finished forms required. The committees are hard at work here and in Washington on this subject. New plans are in preparation for larger steel consumption, particularly in shipbuilding, both on this coast and on the Pacific. At the same time there are new reports of Government plans for laying hold of steel works, but the industry continues skeptical as to all such news, but is in no mood to do business except at the Government's bid. Pig-iron production in May, according to 'The Iron Age,' was at a rate exceeded but once in the history of the industry. The total was 3,446,412 gross tons, or 111,175 tons per day, while that of April was 3,288,211 tons, or 109,607 tons per day. The May output, with charcoal-iron estimated, was at the annual rate of over 40,900,000 tons, exceeding the high record of 39,434,000 tons in 1916. In October 1916, the record month, the daily rate was 113,189 tons. A feature of the output was the production of ferro-manganese and spiegeleisen, which made the surprising total of 54,633 tons, never before exceeded. About 33,000 tons of this was ferro-manganese, also a record.

COPPER

The principal topic in an uninterested market is the probable effect of the increased freight rates on copper costs. It is estimated that the new rates, effective June 25, will add an average of about 1c. per lb. to the present 23.50c. fixed maximum price. Opinions differ as to this, but where there is smoke there must be fire, and it is evident that some effect will follow from this source; how much, time will tell. One result of the coming higher rates has been an active demand on the part of consumers who have metal due them under contract to have as much copper shipped before June 25 as possible. The President has given his official sanction to the continuance of the present copper prices until August 15. What effect this will have on the small producer, especially in connection with the higher freight rates, is differently viewed, especially as to its influence on the output. Already six and possibly eight small mines in Michigan are seriously considering the necessity of closing on the ground that they are producing at a loss at existing prices. The Anaconda Copper Co.'s output in May was about the same as that in March, each month having 31 days for comparison. Exports for the first four months have been 122,106 gross tons, while the April exports are reported as 22,227 tons, the least for any month this year.

TIN

The market continues to sag in all positions, and buyers are looking for still lower levels; therefore they are playing a waiting game. This tendency has been evident for some weeks. As a result the week has been dull and quiet, with practically no business transacted. There is an element of strength in the situation, however, due to a decided restriction and limitation in offerings. It is therefore probable that should buying movement develop, there would be a scarcity of tin, with a resultant general rebound in the market. This may take place at any time, but just when it is hard to guess. Whether the bottom has been touched no one knows, but it is the opinion of a large dealer that it will be a long time before 60 or 65c. tin will be seen again. Prices once more are lower, with spot-metal nominal at about 90c., New York, and future shipment from the Far East at about 85c., also nominal. The recent sinking of more than a dozen vessels in the Atlantic is disturbing to the tin trade, but so far no tin is reported lost. It is hoped that the worst is over. Arrivals at Atlantic ports in May were 846 tons, which is rather small for a month's receipts. The quantity in stocks and landing is put at 363 tons. Arrivals at Pacific ports are not reported. The London market continues to decline. Yesterday spot Straits was quoted at £346 per ton, or £9 less per ton than a week ago. The May average tin price at New York was nominal at $1.01 per pound.

LEAD

Thus far this week there has been considerable enquiry, but it has not developed into large business at this writing, though it likely will. During the week, as a whole, as covered by this letter, the strength as noted last week has further developed, and the market is strong at about 7.20c., New York, or 7c., St. Louis, for early delivery. There have been no sales under the 7c. price of the American Smelting & Refining Co., and it is expected by some that this may be raised soon. The same feature, noted last week, continues to stand forth, namely, a scarcity of prompt lead. The exports in April were 5383 tons.

ZINC

The entire market continues strong but not particularly active. Quotations are firm and practically unchanged at 7.25c., St. Louis, and 7.50c., New York, for early delivery of prime Western, with third quarter held at 7.37½ to 7.50c., St. Louis, but not many willing to quote thus far ahead. No large sales have been reported, but inquiry is fair. The market may be described as quiet. The fact that there is a decided tendency to re-distill prime Western for conversion into grade A is regarded as a 'firming' influence on the prime-Western market, the production of which has probably been curtailed. Grade A is a big factor in war-work, and has been and is still heavily bought by the Government, which is also buying now more grade C than in the past. Exports in April are reported as 7290 gross tons.

ANTIMONY

Quotations continue unchanged at 12.25c., New York, duty paid, for prompt and early delivery, but demand is light. The Government is reported enquiring for a quantity for July delivery.

ALUMINUM

The price-fixing committee of the War Industries Board has changed maximum prices for No. 1 virgin metal, 98 to 99% pure, effective from June 1 to September 1, by adding 1c. per lb. to the former schedule. It now stands 33c. per lb. for 50-ton and larger lots, 33.10 per lb. for 15 to 50 tons, or 33.20c. for 1 to 15 tons. The same quotations are said to apply to scrap aluminum.

Company Reports

AMERICAN, ZINC, LEAD & SMELTING CO.

Property: large mines and mills near Joplin, Missouri, and at Mascot, Tennessee; also zinc smelters in Kansas, and a lead smelter in Missouri.

Operating Officials: H. I. Young, manager of Missouri mines; O. C. Burrell, manager of Tennessee mines.

Financial Statement: profits from operations in 1917 were $1,694,551, plus $85,613 from sundries. An agreement was made with Minerals Separation for flotation license and patent infringement, costing $250,000. On deducting this the profit was $1,530,163. Surplus at December 31, 1916, was $4,904,316, and at end of 1917, $4,594,497.

Dividends: on preferred stock amounted to $483,238, and on common stock, $386,240, equal to $6 and $2 per share, respectively.

General: since the United States entered the War the zinc industry has been greatly affected, due to less demand and attention to other essentials. At the end of 1917, 40% of this country's retorts were idle, including many of the A. Z. L. & S. Co. The Mascot mines produce high-grade spelter suitable for brass in munitions, and all of the output has been sold. The company's natural-gas smelters in Kansas were closed, so it was decided to dispose of the American Pipeline Co., a subsidiary. Operations of the Granby properties in Missouri realized expectations. Although this company devised a flotation process, after Minerals Separation said that it would not be successful, it was decided to pay M. S. $250,000 to settle alleged infringement of patents and become a licensee. The sulphuric-acid works promise to be very profitable during 1918. The Wisconsin Zinc Co., a subsidiary, is making good progress.

BUNKER HILL & SULLIVAN MINING & CONCENTRATING CO.

Property: lead-silver mines, mills, and smelter in Coeur d'Alene region, Idaho.

Operating Official: Stanly A. Easton, manager.

Financial Statement: the revenue in 1917 totaled $10,158,497, of which $9,546,874 was from metal sold and $469,980 dividends from the Caledonia Mining Co. Operations cost $6,306,423, leaving a profit of $3,852,074. Taxes —income and excess profits—were $325,804.

Dividends: these amounted to $2,043,750, making $26,533,500 since 1890.

Development: Bunker Hill & Sullivan reports give little concerning the mines. The main shaft was sunk to No. 15 level, stations cut, and cross-cutting is well under way. Results on No. 14 level were most satisfactory, and indications for No. 15 are good. Reserves total 3,457,419 tons.

Production: the mills dressed 493,030 tons of ore assaying 10.6496% lead and 4.317 oz. silver per ton. Recoveries were 89.51% lead and 79.54% silver. The yield was 93,992,898 lb. lead and 1,692,765 oz. silver. The output to date is 7,886,886 tons of ore valued at $80,247,373, from which there was a profit of $26,261,032.

Costs: these are always given in great detail, and briefly are:

Mines	Per ton 1917	1916	Mills	Per ton 1917	1916
Mining	$2.385	$2.364	Crushing and conveying	$0.066	$0.077
Tramming	0.058	0.059	Screening	0.041	0.045
Hoisting	0.056	0.054	Jigging	0.078	0.073
Pumping	0.046	0.037	Grinding	0.071	0.077
General mine	0.590	0.560	Concentrating	0.101	0.100
			General mill	0.243	0.229

BUTTE & SUPERIOR MINING CO.

Property: mine and concentrating plant at Butte, Montana.

Operating Officials: J. L. Bruce, general manager; Charles Brocking, assistant and cashier; Angus McLeod, mine superintendent; J. T. Shimmin, mill superintendent.

Financial Statement: the past two years compare:

	1917	1916
Smelter settlements, less freight	$6,716,437	$13,141,551
Operating charges and special expense	4,368,941	4,349,420
Reserves for depreciation and depletion	1,941,130	2,508,047
Reserve for excess profit, etc.	236,647	.....
Net profit, plus other income	272,911	6,365,399

The surplus at end of 1916 was $5,672,578. Adding the 1917 profit, and deducting adjustments and dividends, the surplus carried to 1918 was only $651,721. Current assets are $3,234,002, and liabilities $482,331, both decreases. In consequence of flotation and mining litigation net earnings are now being deposited with the Court.

Dividends: four totaling $5.40 per share amounted to $1,567,057. Total to date is $16,940,258, or $59.65 per share.

Development: during June, July, and August operations were affected by labor troubles. A total of 17,730 ft. of new work was done, making 120,271 ft. of accessible openings, three shafts accounting for 5424 ft. The physical condition of the mine is better than ever. The completion of two new shafts have removed all trouble occasioned by the use of only one. On the 1900-ft. level ore of fair grade has been exposed. Reserves amount to 1,059,200 tons, assaying 17.6% zinc and 5.9 oz. silver per ton, a slight increase in quantity.

Production: details appeared on page 764 of the 'Press' of June 1; but 461,953 tons, averaging 15.47% zinc and 5.8 oz. silver per ton was dressed by concentration and flotation. This quantity was 25% less than in 1916, due to suspension of operations. The mill needs few improvements in the future. Concentrates were sold to the A. Z. L. & S. Co., U. S. S. Co., and A. M. Co. They contained a total of 132,036,735 lb. zinc, 11,098,051 lb. lead, 1,329,570 lb. copper, 2,527,302 oz. silver, and 3918 oz. gold.

SHANNON COPPER CO.

Property: mines at Metcalf and reduction works at Clifton, Arizona; also control of Shannon Arizona Railway Company.

Operating Official: J. W. Bennie, general manager; H. H. Dyer, mine superintendent; W. H. Bond, mill superintendent.

Financial Statement: metals sold in 1917 realized $1,824,947. Operations cost $1,536,401, plus $127,327 for special charges during the strike. The net profit was $184,968. At end of 1916 surplus was $1,337,771, but after paying dividends, depreciation, etc., the balance at December 31, 1917, was $836,284. Current assets were $486,087 above liabilities.

Dividends: four amounted to $525,000.

Development: owing to strikes only 7 months work was done. Additional oxide ore continues to be uncovered, but became too poor to be smelted direct at a profit, so this is to be eliminated and only sulphide ore mined. A promising mine purchased in the Yeager Canyon district should commence producing by July 1918.

Production: 157,000 tons of company ore and 13,800 tons of custom ore yielded 6,138,219 lb. copper, 1096 oz. gold, and 51,771 oz. silver.

Costs: wages are 120% higher than in 1914, fuel-oil advanced from 37½c. in 1916 to $1.35 per barrel, coke is $8.60 per ton, against $3.75 in 1914, and lumber is $10 per 1000 ft. higher.



INFORMATION FURNISHED BY MANUFACTURERS

TRAYLOR ENGINEERING & MANUFACTURING COMPANY

At a meeting of the board of directors of the Traylor Engineering & Manufacturing Co. at Allentown, Pa., held on April 16, S. W. Traylor resigned the presidency and W. J. Roberts was elected in his stead. Other changes were the election of Mr. Traylor to the chairmanship of the board of directors, and Harry Battersby, who was previously treasurer of the company, was chosen as first vice-president and treasurer. F. W. Hopkins, second vice-president, and F. R. Crispen, secretary, were retained in their present positions, and H. L. Miller and Richard Bernhard were added to the directorate. In addition to the chairmanship of the board of directors of the Traylor company, Mr. Traylor still occupies the position of president and general manager of the Traylor Shipbuilding Corporation, of Cornwells, Pa., and president of the Cement-Gun Co., Inc., both of which are subsidiaries of the Traylor Engineering & Mfg. Co. W. J. Roberts has been connected with the Traylor company for 12 years, having advanced step by step through its entire organization, and his election to the presidency will be welcome news to many friends. He is particularly well known in the metal mining districts throughout this country and Mexico, and his personal acquaintance is of an extensive character. The election of H. L. Miller and Richard Bernhard to the directorate will appeal to the many users of machinery. Mr. Miller has, in addition, been appointed general manager of the company, a position for which he is exceptionally qualified, on account of his long experience as general superintendent and assistant general manager for the Power & Mining Machinery Co. of Milwaukee. Mr. Bernhard occupies the position of chief engineer, the same that he held with the Power & Mining Machinery Co. previous to his connection with the Traylor company about one year since. The Traylor company has within the past year completed extensive additions to its plant, the new machine shop being considered one of the model buildings of this type in the country. In addition to the manufacture of mining and crushing machinery, the Traylor company has recently taken on the manufacture of marine engines and boilers and has completed the first engine for the new mercantile marine now being pushed to completion by the U. S. Shipping Board. The company proposes after the War to continue in the manufacture of ships and shipping machinery. Due to the close affiliation with the Traylor Shipbuilding Corporation it will be able to turn out complete ships.

1480 RIVETS IN FOUR HOURS

Peerless No. 4810 air-hose was used in a remarkable competition in driving rivets made under handicap at the Morse Dry Dock & Repair Co.'s plant in South Brooklyn, recently. Bertram Bieher, riveter, and his holder-on Eddie Hesse, with four heater boys, drove 1480 regular size three-quarter inch button-head rivets in four hours and ten minutes. As the men were forced to travel 34 ft. for every 18 rivets driven and worked on girders on which the rivets were 12 in. apart, the conditions were considered unusually trying in shipbuilding circles. Despite the handicap the men worked faster each hour until 10 minutes before completing the job. The rates of driving were, 352 rivets in the first hour, 360 in the second, 361 in the third, 362 in the fourth hour, and 45 in the last ten minutes. For a record of this kind it is obvious that air-hose plays an important part in rivet driving. It would not do to have to stop to make repairs. No. 4810 air-hose made by the United States Rubber Co. is a well constructed hose that will not kink, is non-leakable, and is impervious to the action of oil.

'WESTERN' ENGINES FOR INDIA

A shipment of 'Western' engines destined for Cawnpur, approximately in the central part of India, has been reported for export from San Francisco during the past week. The engines are to be used to furnish power for an irrigation project, the details of which are not available at this time, but which is said to be of large proportions. The Western Machinery Co. of Los Angeles, manufacturers of 'Western' engines, are building up a profitable business in the export field, and their engines are meeting with success abroad, being particularly adapted to a wide range of conditions and fuels. Among recent sales reported by the Western Machinery Co. are two 50-hp. engines to Clampitt & Moss., Los Angeles; one 20-hp. engine to Layne & Bowler Corporation, Los Angeles; and one 60-hp. engine and one Layne & Bowler pump to the Toltec Townsite Co., Arizona.

A plan to irrigate extensive holdings in Lake and Yolo counties, situated in the central part of California, has just been brought to light through the reported sale of a large amount of irrigation equipment to the Yolo Water Power Co. of Woodland. Heretofore these properties have been irrigated by gravity ditches from Clear lake, which is in the central part of Lake county, but owing to the fact that the lake waters have receded to a considerable extent due to the long dry season during the early part of this year, it is necessary to pump the water to the head of the ditches. This project requires a plant of large proportions, which already has been contracted for by the Yolo company. 'Western' engines, manufactured by the Western Machinery Co. and Byron Jackson pumps, manufactured by the Byron Jackson Mfg Co., both of Los Angeles, California, constitute the equipment decided upon for this project after careful and exhaustive investigations. The sale of 'Western' engines was made by the San Francisco office of the Western Machinery Co., this office being in charge of J. R. Johnston as manager.

The Allis-Chalmers Manufacturing Co. has brought out a new edition of its special catalog on Cyanide Plants and Equipment, No. 106. Following the admirable custom of this firm it has given in this handsomely illustrated book of 112 pages a brief résumé of the technique of the crushing and treatment of gold ores, according to modern practice. A valuable table is one that gives the specific gravity of the pulp corresponding to its dilution and to the density of the

comminuted mineral matter it contains, together with the number of cubic feet of such pulp per ton, and the cubic feet of pulp equivalent to one ton of the original ore. The range is from a density of pulp of 1.031 (dilution ratio 1:9) for ore of 2.5 sp. gr., up to ore of 3.3 sp. gr. giving a density of 2.195 for the pulp when diluted in the ratio one of solid to 0.429 of water.

COMMERCIAL PARAGRAPHS

To provide for greater operating resources, the **British American Metals Co.**, 52 Vanderbilt avenue, New York, has increased its capital from $100,000 to $1,000,000.

The International Paper Co. is drawing plans for the rebuilding of its sulphite plant at Watertown, New Jersey, recently destroyed by fire. A. H. White, chief engineer, will be in charge.

The Southern Minerals Corporation, operating at Elizabethton, Tennessee, is arranging for extensive development of iron-ore and bauxite properties south of the city. B. D. Harmon is treasurer of the company.

The Shenandoah Valley Manganese Corporation, Pittsburgh, Pennsylvania, recently incorporated with a capital of $1,500,000, will operate manganese properties at Stanley, Virginia. George S. Davison and Albert P. Meyer are president and secretary, respectively.

The William Wharton, Jr., Co., Easton, Pennsylvania, is planning for the early operation of a new blast-furnace. The plant will be electrically operated, power being furnished by the Pennsylvania Utilities Co. The output of the works is devoted largely to the manufacture of steel rails.

The Seminole Phosphate Mining Co., Croom, Florida, recently incorporated with a capital of $60,000, will establish a plant for the production of soft phosphate with a daily capacity of about 100 tons. It is planned to increase this output later to 200 tons per day. W. F. Walker is president.

The new steel works of the **Worth Brothers Co.,** near Claymont, Delaware, is rapidly being completed and plans are being formulated to operate the works at the earliest possible date. The main building, with a number of auxiliary shops and structures, will represent a cost of about $1,000,000.

The American Zinc, Lead & Smelting Co., 120 Broadway, New York, operating at Mascot, Tennessee, is planning for extensive mining development on adjoining property. The company is also considering the construction of a new smelter, as well as the installation of the electrolytic process for zinc production.

The Midvale Steel & Ordnance Co., Widener building, Philadelphia, is considering the employment of women at its Nicetown machine shop and at its wire mills at Johnstown. Up to this time, the company has sought to employ men for the different classes of work at its mills. The proposed change is to provide against a prospective shortage of male labor.

The British-American Chemical Co., 52 Vanderbilt avenue, New York, is planning for the construction of several large buildings at the former works of the Old Tennessee Copper Co., at Ridgefield Park, New Jersey. The Eastwick Engineering Co., 82 Beaver street, New York, will design the structures, with the installation of equipment in charge of C. F. Blackmore, purchasing agent.

The Cherokee Mining Co., Spartanburg, South Carolina, operating copper plants at Blue Ridge, Georgia, and Copper Hill, Tennessee, has organized, with C. R. Willard, president; W. G. Willard, vice-president; R. E. Boggs, secretary-treasurer; and E. L. Hertzog, manager. The present plants have a daily capacity of 200 and 500 tons, respectively, and it has been reported that plans for extension are being considered.

The Butterworth-Judson Co., Newark, New Jersey, operating large chemical works on Avenue R, has secured a contract from the U. S. Ordnance Department covering the construction and operation of a large picric acid works at Brunswick, Georgia. The proposed plant will cost about $7,000,000. With a second plant of the same nature, to be erected for the Ordnance Department at Little Rock, Arkansas, and costing $3,000,000, the Government is establishing the first Federal-owned picric acid plants.

J. Meyer & Sons, manufacturing and importing chemists, of Philadelphia, manufacture a large number of chemicals for the varnish, paint, glass, steel, oil-cloth, printing ink, and linoleum trades, as well as a full line of varnish gums. The following list shows the range of products: resinates (precipitated), manganese resinate, lead resinate, zinc resinate, and calcium resinate; resinates (fused), manganese, lead, zinc, and cobalt resinate; linoleates of manganese, lead, and calcium, and umber, burnt and raw lump; stearates of calcium, zinc, and aluminum. Also they produce manganese compounds, including manganese sulphate, manganese oxide of all grades, hardening powder for resin, manganese chloride, and manganese borate.

The Smith & Travers Diamond Drill Co., Ltd., and the Smith & Durkee Diamond Drilling Co., Ltd., both of Sudbury, Ontario, have disposed of all of their assets to a new company to be known as the Smith & Travers Co., Ltd. The capital is $500,000, divided into 5000 shares of $100 each. The management includes active members from both of the old companies, who have had considerable experience in exploring mineral lands and in technical direction. T. E. Smith is president, Thomas Travers vice-president, and T. H. Hale secretary-treasurer. Others on the staff are O. R. Smith, W. H. Smith, and C. H. Hitchcock, all well known in Ontario. The company owns 34 drill outfits, capable of drilling shallow holes or to as deep as 3000 ft. A repair-shop is maintained. For the proper exploration of properties a complete geologic department is available, to examine cores, make analyses, and compute tonnages. Hereafter it is proposed to assist in development by doing work on meritorious properties in return for an interest in them. In nickel lands the firm has had a great deal of experience.

The United Filters, of Salt Lake City, recently issued a trio of valuable catalogs descriptive of the Kelly, the Sweetland, and the American Continuous filters, being bulletins No. 100, 101, and 102 respectively. They are profusely illustrated, and give valuable information on the construction and use of the various types of filtration machines mentioned. At the present time, more than ever before, filtration problems are engaging attention owing to the great expansion of the chemical industries; these bulletins, therefore, are most timely.

The Sullivan Machinery Co. announces the establishment of a branch office at Washington, D. C., at room 210, Union Trust building, corner 15th and H streets, N. W. Ralph T. Stone, associated with the New York office of this company, will be in charge. The establishment of this Washington office will, it is hoped, be of convenience to clients and customers in Washington and vicinity.

The Magnolia Metal Co. has erected a smelting plant for the treatment of antimony at Matawan, New Jersey, 29 miles from New York City. This plant is equipped for operations on a large scale. The main offices of the Magnolia Metal Co. are at 113 Bank street, New York.

H. H. Hollowell, sales-manager, and **Art Houston,** advertising manager of the Western Machinery Co. of Los Angeles, are making a tour of the company's offices in the oil districts.

Mining and Scientific Press

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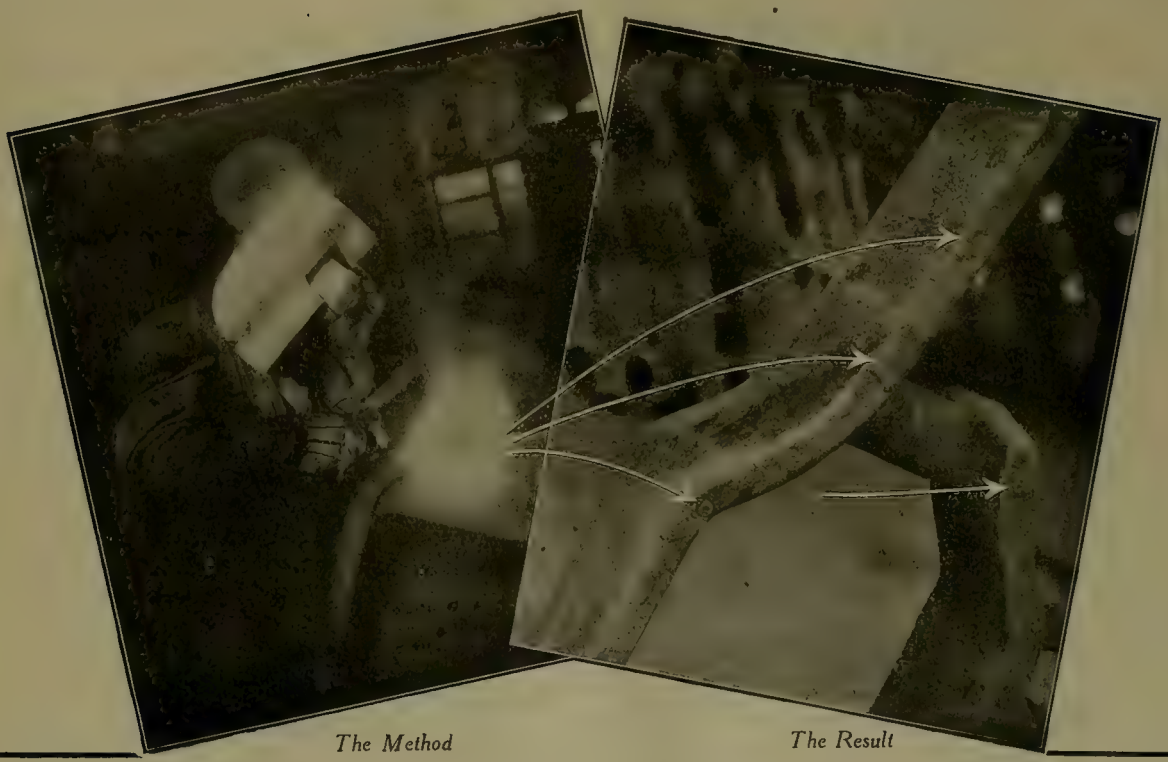
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REFERRING to the letter 'from the front' appearing in our last issue, we are pleased to say that we have received three offers to pay the subscription of the engineer-soldier who wrote that letter. We are glad to add that the matter already had been arranged in a satisfactory way.

ONTARIO has a number of new townships named after distinguished mining engineers and geologists, the christening having been performed by the Bureau of Mines in that Canadian province. Those whose names have been thus honored are William Frecheville, F. Lynwood Garrison, Alfred Harker, George T. Holloway, G. W. Lamplugh, Hugh F. Marriott, Charles F. Rand, and Bradley Stoughton.

BY resolution of the Board of Directors of the Institute, all members and associates that are enemy-aliens have been dropped from the roll. This will apply to three honorary members, Professors Beck, Schroedter, and Hoefer; also to 18 ordinary members in Germany. How many alien-enemy members there are besides those resident in Germany, we do not know. Professor Hoefer is the only member in Austria.

OUR news-columns have recorded the U. S. Supreme Court's decision affirming the judgment of the Nevada court in the case between the Jim Butler and West End mining companies at Tonopah. The Supreme Court decided (1) that the highest point of an anticlinal roll in a vein may be considered as an apex, vesting in the owner, therefore, the right to follow the vein on the dip in both directions outside the side-lines of the claim containing this so-called apex; and (2) that the broken end-lines in the West End claim do not bar the exercise of such extra-lateral rights. The decision is one of far-reaching importance; we consider it most unfortunate, because it reduces the law of the apex to an absurdity. At an early date we hope to publish some further remarks on the subject.

IN our news columns of May 25 it was reported that a standardized method of assaying drill-cuttings was to be adopted in the Komspelter region. So many systems were used that it was difficult to tell how to appraise the results. Recent advices state that twelve of the leading assayers in the region have formed a committee to standardize the method of assaying zinc ore. Mr. W. G. Waring, well known at Joplin, is chairman. A report will be made at an early date. Incidentally, the Tri-State Mine Safety and Sanitation Association, through its chairman, Mr. Temple Chapman, at Picher, Oklahoma, gives some interesting figures on the cost of producing zinc and lead concentrate in the Komspelter region. The cost is as follows: mining and milling, $38; royalty on leases, $8; depreciation and depletion, $10; making a total of $56 per ton. The value of the product shipped last week was $50, showing a loss of $6 per ton on the production; but we presume that this depressing estimate of cost was made with an eye to melting the hard hearts of the price-fixers at Washington. However, we appreciate the difficulties of the zinc miners; they have suffered keenly from the effects of delay in governmental action.

STANDARDIZATION of mining statistics is the subject of Technical Paper No. 194 just issued by the U. S. Bureau of Mines. The compiler is Mr. Albert H. Fay, whose name is familiar in connection with the kind of publications that are usually deemed arid, although they are fertile in suggestion and generalization to those that know how to "read, mark, learn, and inwardly digest them" without suffering from mental dyspepsia. Speaking seriously, this report was prepared on the initiative of a committee appointed by the U. S. Bureau of Mines in February 1916 at a meeting of State mine inspectors and representatives of industrial-accident compensation commissions. At that time twelve standardized forms were presented for discussion, and Professional Paper No. 194 embodies the points that were brought out during that discussion. It is now submitted with the hope that it may be adopted by those that were originally consulted and by others engaged in similar work. The need for standardization is obvious to those whose duty it may be to co-ordinate data from the reports issued in various States. We commend both the pamphlet and the motive that brought it into existence.

CALIFORNIA, says Mr. Ralph P. Merritt, in proportion to her population, is shipping more food to Europe than any other State in the Union. We are proud of that. The United States is feeding 120 million people

in Europe in addition to the 110 millions in this country, and this *ravitaillement* is being effected despite a decrease of 11 millions in productive man-power. Of the 170 million bushels of wheat to be shipped to Europe from the 1917 crop all but 20 million bushels is due to the voluntary conservation of the American people under the leadership of Mr. Herbert C. Hoover. Last month 300 million pounds of hog products and 140 million pounds of beef were forwarded to Europe, and these totals will be more than maintained until victory releases our Allies for the production of their own foodstuffs. It is highly satisfactory to note how completely the Food Administration has won the national confidence. This is greatly to the credit of the Administrator, Mr. Hoover, who began his task under enormous difficulties but has won support by his sincerity and ability. That ability has been shown in his choice of lieutenants. The public in California recognizes in Mr. Merritt a man peculiarly fitted to be State Director and is glad to stand by him in the fulfillment of his difficult duty.

VENEZUELA has been heard from. The silence of the press regarding that republic has long excited suspicions that something was wrong. It argued a control upon the news at its source, and the fact that the Krupps and the cartels linked to them had long been prominent in Venezuelan financial and commercial circles left little doubt as to the dominating influence. Señor Carlos Lopez Bustamente has reached New York with a tale of imprisonment at Carácas, the capital, for daring to publish editorials favoring the Allies. After eight months he escaped and was smuggled on board a ship bound for the United States. He hints at a possible U-boat base on the Venezuelan coast, which could mean only the gulf of Maracaibo. That seems hardly likely, because the entrance would be relatively easy to guard by our warships stationed near-by at the Panama Canal. We think there are greater possibilities of hiding in the intricate system of lagoons and coral islands along certain parts of the western shore of the Carribean. Nevertheless, it will be well to keep a close watch upon President Juan Vicente Gomez, who rode into office on horseback in the customary melodramatic manner, and must needs have his reward. Incidentally, the Barber Asphalt Company, in Venezuela, may at last take unction to itself for having been beaten by the Germans in winning favor with the authorities at Carácas.

GREAT dissatisfaction pervades the world of copper-producers. Rising prices of commodities have involved a large increase in the wages paid, all supplies have advanced from 50 to 200%, and the cost of producing the metal has grown in proportion. The copper market is suffering as are all markets that are 'regulated,' because regulation has not at the same time protected them from the exorbitant prices current in the industries that are still free from Government control. The latest suggestion is reported in our New York metal-market letter this week. Some one in Washington has hinted at setting apart 15% of the output to be sold in an open unrestricted market, the remaining 85% to be distributed under Government orders at the price of 23.5 cents. We do not believe this will prove more pleasing than the existing arrangement. It will introduce feverish speculation, which is altogether undesirable at this time; it will seriously affect many manufacturers working on orders from private corporations, such orders in reality constituting part of the work needed under contract to the Government. It is almost impossible in these days to disentangle production for the people at large from that required in the military activities of the nation. Juggling with prices is a dangerous thing, except on the basis of a single rule for all. The fruit of cultivating an economic fallacy is a harvest of errors that furnishes seed for increasing crops of evil.

PRESIDENT FAUNCE of Brown University has stated recently that we are fighting "the power of misapplied science." All our dreams of a world to be rendered more pleasantly habitable by grace of scientific discovery have been shattered by the beast with the brains of an engineer. He has prostituted science to piracy, and invention to the filthy cruelties of an Apache. War used to be limited in its calamitous scope, first, by a sportsmanship expressed by chivalry, and, second, by the fact that it was waged by relatively small armies of professional soldiers, leaving the nations not only as backers whose fortunes were determined by the result of the contest but as peoples detached from the fighting itself, even in case of invasion. Now whole nations are fighting, the entire physical and industrial resources of the leading peoples of the earth are being pitted against each other, and the imminence of a prolonged, cruel, and devastating war is being brought home to every fireside in the civilized world. The Germans are waging unlimited war, unlimited in its use of every resource, unlimited in its disregard of every convention, decency, or morality. Science has been mobilized by them to the fullest extent in order to kill, maim, or poison those whom they have attacked wantonly in their highly organized purpose to win world dominion. Atrocities are concocted in the laboratory, murder is designed by strictly scientific method, poisoning is planned by chemists and bacteriologists, demoralization of the enemy is devised by psychologists. Science has been forced to play the dirtiest game in all history. And the Allies must retaliate. The cruelty of any war is determined by the most cruel of the contestants, because, unfortunately, there is no way to check cruel methods except by others like them. The desperado must be killed, the spy must be shot, the user of poison-gas must be driven back by a more deadly gas, the submarine must be sunk by the depth-bomb. Chivalry has been destroyed. The Hun sneers at "slave morality" and glorifies "the will to kill." *Habet.* We must meet him on the ground he has selected, beat him by his own scientific method, but always disdaining to use the obscene cruelties and the filthy bestialities that he, led by a military caste without a sense of honor, has introduced into warfare.

Flotation Litigation

It is announced that the Minerals Separation company has decided to take an appeal to the United States Supreme Court from the recent decision of the Ninth Circuit Court of Appeals in the Butte & Superior case. This appeal will probably be heard at the October term. In issuing its decree the Appellate Court made an extraordinary blunder, as our readers are aware, in assuming and stating that the Butte & Superior company had never used less than 0.5% of oil per ton of ore, whereas the fact, as stated clearly in the briefs and in the pleadings of both parties to the suit, was that the Butte & Superior company had used more than 0.5% only since January 7, 1917, that is, immediately after the U. S. Supreme Court, in its adjudication of the Hyde case, had restricted patent No. 835,120 to the use of a critical proportion of oil as described in the testimony and in the patent. If the Appellate Court in San Francisco had not corrected its decree, the decision would have been reversed or at least modified by the Supreme Court, although the error made was a plain oversight of admissions appearing in the record and conceded by both litigants. Next arises the question: What will the Supreme Court do? First comes the petition for a writ of certiorari to be presented by the loser in the recent appeal in San Francisco. As a matter of statistical average it can be stated that of such petitions for a review only one in six is granted. The right of ultimate appeal follows as a matter of right whenever a question involving the interpretation of Federal law appears in the face of the complaint. No such question arises in the case under discussion; but another reason for a review before the Supreme Court is "a principle of far-reaching importance," which apparently does arise in this instance and which may therefore cause the Court, as a matter of grace, to issue certiorari. Again, the Butte & Superior case involves an effort to interpret a previous decision of the Supreme Court in a similar controversy, namely, the Hyde case. It is customary for the Supreme Court to grant a review if it is necessary to clarify the effects of its previous judgment. Moreover, a conflict of decision between two courts of appellate jurisdiction, such as has arisen between the Third Circuit Court of Appeals in the Miami case and the Ninth Circuit Court in the Butte & Superior case, would be deemed to justify the granting of a petition for a review. In the main, it may be said that the Supreme Court can do, and does, as it pleases, but it has itself laid down sundry rules of procedure as we have outlined. Under the circumstances it is vain, if not unseemly, especially for those unversed in legal matters, to forecast the outcome of a petition for certiorari to be presented, as we are informed and as was to be expected, by the Minerals Separation company. If a review be granted then it would appear likely that the Supreme Court would sustain the opinion of the Appellate Court because the opinion seems to be a logical sequel to its own dictum; in short, the Supreme Court may consider the recent decision in accord with its previous judgment. The fact of there being a dissenting opinion would be disregarded. We wonder what the Supreme Court will think of the insistent assertion, by Minerals Separation in the Hyde case, that the success of experiments made with an excess of oil was due to laboratory tricks such as could not be confirmed on a working scale, having regard to the fact, now affirmed in the Butte & Superior record, that mills were getting an excellent metallurgical result at the rate of 1000 tons per diem within 60 days after the decision in the Hyde case was published. The Miami case is now in the stage of proceedings for an accounting. In the event of a disagreement over this accounting there may at any moment arise a need for an appeal to the Third Circuit Court of Appeals at Philadelphia, and eventually the Miami case also might be brought before the Supreme Court. A similar accounting for infringement before January 7, 1917, will be made against the Butte & Superior company, but punitive damages, we understand, are not collectable by Minerals Separation, despite sundry threats to do so. The measure of damages will be the difference in profit as between the use of the patent infringed and the nearest alternative process. Here also a dispute may necessitate further reference to the Court of Appeals. The litigation is by no means at an end, but it is approaching a logical conclusion.

An Expanded Monroe Doctrine

Comment upon the remarks made by the President the other day to the Mexican editors that are touring the United States has assumed too hastily that a promise of non-intervention under any circumstances was implied. We fail to find warrant for construing the words of the address in that sense. We must recall that confidence in the reasonableness of Germany, and assurance of our willingness to maintain amicable relations with her, colored every communication sent from Washington up to the one that carried the thunderbolt of outraged humanity. It is not the custom of those versed in statecraft to use the blunt phrases admissible in common speech. Mr. Wilson now reiterates the kind feeling of America toward Mexico, the proofs of which have been accumulating through the past eight years, and he directs attention to supreme examples of our unselfish efforts to promote the welfare of that country, while at the same time he intimates delicately how our acts have been misinterpreted. He re-affirms our earnest desire to cooperate with our neighbor in a friendly manner, but he also refers pointedly to the German activities permitted under shelter of the Mexican flag, which have become increasingly aggravating since we entered the War. The President's utterance is diplomatic, and he makes excellent use of innuendo to convey a warning the significance of which will not be lost upon a people accustomed as are the Mexicans to subtle suggestion in their speech. At the same time he gives assurance of our desire to live on terms of cordial fraternity with Mexico and to safe-

guard not only her territorial integrity but that of every other republic in the western hemisphere. Thus he has expanded the Monroe doctrine into a declaration of national rights to be respected as much by ourselves as by empires across the seas. This is the answer given to Carranza's appeal to the other Spanish-American countries that they adopt a 'neutrality' of a sort that would exclude commerce with us and our Allies while the blockade against Germany existed. This is the reply to the insinuations in Señor Càndido Aguilar's note to Cuba that she is a bond-servant of the United States. In the face of the President's declaration, which puts the bar to our further territorial growth in the Americas, Carranza will recognize that the inalienable rights of his country have received the stamp of formal recognition by the United States, and he will not fail to note that the counterpart to every right is a corresponding duty.

A 10% Tax on Commodities

The report on commercial bribery submitted to Congress last month by the Federal Trade Commission should have awakened an instant response. It touched one of the cankers of modern trade; it revealed how business in the United States has suffered from a monstrous evil, preventing the proper flow of trade on a genuinely competitive basis, increasing the cost of nearly every article of commerce by 10% or more; and it showed that the vice of commercial bribery in this country had been turned to account by the Teutons before the War in an effort to enslave the American to German manufacturers. Since the outbreak of hostilities the corrupt practice has been continued by hyphenated firms and corporations, one object of which evidently is to keep these people in line for readier dominance . . . in the event of certain catastrophies to American arms that aren't going to happen. We have been surprised that Congress received the report with so little sign of interest. Indeed, barring sundry remarks by Senators Brandegee of Connecticut, Smith of Michigan, Johnson of California, and Chamberlain of Oregon, Congress has done little that was spontaneous and refreshing for many months. More than this, no real publicity has been given to so astounding a report prepared by one of the most important commissions in the country. The almost universal silence after it appeared was as remarkable as the revelations in the document itself. At a time when gold mining is nearly crushed by exorbitant costs while the commodity-value of the output is approximately 48% less than its nominal value; when the Chino company reports an increase of 126% in three years in the cost of its copper, closely followed by Utah Copper with 113%, and Nevada Consolidated with 81%; when mining has been rendered so precarious that guaranteed markets have become essential to the existence of many branches of the industry; when these conditions threaten an adequate response to the national need for mineral products, it would be a great boon to follow the recommendation of the Federal Trade Commission, and enact legislation to stamp out this iniquitous graft. To do so would result in lowering the average cost of manufactured commodities by 10%. The report of the Commission says, "These bribes take the form of commissions for alleged services, of money, and gratuities and entertainments of various sorts, and of loans—all intended to influence such employees in the choice of materials. . . . Corrupt employees having the power to spoil and disapprove materials have been able to bid one salesman against another until in many cases they have extorted secret commissions, so-called, as large as 20% of the value of the goods sold." In another place the report declared, "It is useless to discuss the origin of the practice. It is sufficient to know that it exists generally and appears to be spreading . . . that it must engulf even those honestly inclined if they desire to maintain their commercial life. . . . It should also be noted that the practice appears to have been most general on the part of concerns in introducing the goods and wares of German firms. Among such concerns and their salesmen the evidence is that the practice is recognized as a legitimate method of competition."

This is enough to justify the people in demanding that Congress make haste to pass the bill introduced into the Senate by Mr. Albert B. Cummins for carrying into effect the recommendation that such a measure was required "in the public interest as an aid to the preservation of fair and free competition, striking at the unjustifiable and vicious practices of commercial bribery."

Every mining engineer that has charge of extensive operations can cite mystifying instances where drill-steel that he knew to be sound was condemned as a failure by his drillers and his tool-dressers; where a brand of lubricating oil that he had found eminently satisfactory elsewhere persistently gave poor results in his new mill, while another brand that he believed to be inferior suddenly produced an effect that by contrast was marvelous. We have all seen examples of the concentrator that would not treat its full load of pulp without losing its powers of discrimination between mineral and gangue, while a machine, based on the same mechanical principles, but in an altered form, would render creditable service, although these conditions were exactly reversed in the mill across the canyon. The excuse of a subtle difference in the ore is not always the correct explanation. The exposition of corruption that has just been made by the Federal Trade Commission comes nearer to offering a solution of the puzzling behavior of well-known brands of steel and oil, of picks and shovels, and car-wheels, and the mysterious superiority in the steaming power of certain coals over others that the foreman rejects despite their higher proportion of fixed carbon and their lower content of ash. Thirty years ago the bribery of managers by purveyors of mine equipment was nearly universal, but the gradual substitution of the trained engineer for the 'rough-neck' brought with it a reform. Truth and honor are allies, and the scientific training inculcates respect for the actualities that are revealed in

scientific study and research. The habit of looking for and stating the truth develops in the engineer a fine sense of rectitude, quite apart from any special moral culture that he may have received, and this has done much to elevate the tone of the mining business. The selling agent that would practice commercial bribery is afraid to visit the manager's office today with insinuations of easy money to be had by putting corrupt self-interest ahead of duty to his company. The mining engineer stands for a higher code of ethics, and is eager to support legislation that will help him to conduct his business in a clean way without interference from bribe-givers and bribe-takers. He will stand on the side of those who realize that graft must be eliminated, and that if these and other means be not taken to reduce or to equalize the costs of commodities, financial disorders will presently embarrass the Government and the people. We may differ as to policy, but Americans will be a unit in demanding a clean government and a clean commercial life. This Teutonic method of doing business was prohibited in Great Britain by Act of Parliament as much as 20 years ago; there is no reason for our failing to do likewise, for we are at heart an honest nation. The bill should be passed at the present session of Congress.

Pulverized Coal

The restriction upon industry resulting from the difficulties of mining and transportating the large quantity of coal demanded by manufacturers must be relieved by utilizing every possible resource. Mechanical efficiency, giving higher returns in power delivered per unit of fuel consumed, is as much a resource as the development of more coal. In another column we print an article by Mr. W. G. Wilcox on the use of pulverized coal. The subject is attracting greater interest every day. The idea is not new; in fact, powdered fuel has been used to a considerable extent for twenty years or more. It was applied long ago to the burning of cement-clinker in rotary furnaces, and was found to yield superior results. A long flame is detrimental to the successful burning of the 'mix,' and coal-dust admits of perfect combustion close to the jet delivering the air and the fuel. The construction of the long rotary cement-kiln made it imperative to accomplish this result, for if the combustion does not take place at once, a long smoky flame will extend throughout the length of the kiln, since air cannot be introduced at other points than the firing-end of this apparatus. It is surprising that so much hesitation has been displayed in adopting pulverized coal for boiler firing, but manufacturers are inclined to be slow in departing from the conventional paths. The exigencies of war, however, are compelling a more scientific application of fuel, and this improvement offers a means for relieving the stringency caused by a lack of sufficient miners and of adequate facilities for transportation. Thus war, with its ruthless waste and destruction, draws in its train economies that will persist in our industrial life, and aid in the solution of urgent problems of conservation. One notable achievement in the use of powdered coal has been seen recently in copper metallurgy. The principle of burning fuel so that it is nearly all converted into carbon di-oxide close to the jets, producing a short hot flame, is revolutionizing reverberatory practice. Furnaces built with a rated capacity for smelting 500 tons of ore per diem now smelt twice that amount, without necessitating any structural changes. The settling of the matte from the slag is improved, and the heat-recovery by water-tube boilers in the flue is as good as under the old system of firing. The principle is applicable whether oil or coal be used as fuel, but it is more effective with pulverized coal. At the Steptoe plant of the Nevada Consolidated Copper Company this system was introduced in April, resulting in the conservation of approximately 1400 barrels of oil daily, based on the increased tonnage of ore that could be smelted. It was also found to be possible to treat a more refractory charge than when firing was done with oil, and a better distribution of heat in the furnace was obtained. The dried pulverized coal is fed into the suction of a series of fans, which deliver it through a 'pipe-header,' the ratio of 50 cubic feet of air per pound of coal being maintained. The total saving in cost is said to be quite large. Mr. Wilcox in his article points out that the rate of combustion depends upon the total surface of coal exposed to the air at a temperature high enough for instant ignition, and as the specific surface is increased by fine grinding the condition for rapid and perfect combustion is thereby improved. This, however, is only part of the story. His statement that, by comminution, "we have changed entirely the characteristics of coal as commonly known" is extremely significant. Pulverization reduces a considerable proportion of the coal to a degree of subdivision so minute as to bring it within the colloid realm. This partly explains the fact that it burns in a manner analogous to gas, for a colloid consists of but a few molecules, and a colloid particle behaves similarly in many respects to the individual molecule, such as exists in a gas. Furthermore, the greater the specific surface of a solid the greater is its power of adsorption for gases, and carbonaceous colloids are remarkable for the quantity of oxygen that they adsorb from the air. On account of its minutely cellular structure, ordinary charcoal adsorbs 9¼ times its own volume of oxygen, and the quantity adsorbed by colloidal charcoal is much greater. Coal does the same thing, though to a somewhat lower degree than charcoal, but herein lies the explanation for the extraordinary approximation to the theoretically perfect combustion that is obtained by the use of this pulverized fuel. A great store of oxygen is condensed upon the colloidal particles ready to effect instantaneous and complete combustion on being brought into the high temperature of the furnace. Where the object is to secure the highest possible temperature with the most economical consumption of coal no other method of burning should be employed. It saves money, saves man-power, saves railroad equipment, and helps to carry to a successful conclusion our paramount business of crushing Germany.

Table for Sulphidizing Solutions

By K. B. THOMAS

Sodium sulphide is being used in a number of plants for sulphidizing ores for flotation, and the practice is growing rapidly. Recently I learned from an operator who is thus employing sodium sulphide that his custom in preparing the solutions is to make them up and then determine the percentage of Na_2S present in them. This work could be eliminated by means of the table given herewith, which I had occasion to prepare a short time ago, from solutions of the commercial sodium sulphide.

Sodium Sulphide Liquor

Degrees Baume	Grammes Na_2S per 100 gm. solution	Na_2S %	Na_2S per cu. ft. of solution, %
1.0	0.955	0.85	0.59
2.0	1.166	1.15	0.73
3.0	1.582	1.55	0.99
4.0	2.107	2.05	1.31
5.0	2.692	2.60	1.68
6.0	3.337	3.20	2.08
7.0	3.990	3.80	2.49
8.0	4.655	4.40	2.81
9.0	5.330	5.00	3.33
10.0	6.068	5.65	3.79
11.0	6.762	6.25	4.22
12.0	7.575	6.95	4.73
13.0	8.235	7.50	5.15
14.0	9.021	8.15	5.63
15.0	9.923	8.90	6.20
16.0	10.790	9.60	6.74
17.0	11.724	10.35	7.32
18.0	12.552	11.00	7.84
19.0	13.512	11.75	8.44
20.0	14.442	12.45	9.02
21.0	15.547	13.30	9.71
22.0	16.504	14.00	10.31
23.0	17.642	14.85	11.02
24.0	18.629	15.55	11.65
25.0	19.811	16.40	12.38
26.0	21.010	17.25	13.13
27.0	22.080	18.05	13.80
28.0	23.788	19.20	14.87

The above are all on a basis of solution at 60° F. For the difference in temperature the correction in Baumé should be made as follows: Add 0.1 degree Baumé to the reading for each 4 degrees that the solution is above 60° F. For example: If the solution tests 12° B. and 100° F., then $100-60=40\div 4=10\times 0.1=1.0$. The true Baumé reading then is $12+1=13°$ B. at 60° Fahrenheit.

Reactions of hydrogen peroxide were investigated recently by V. Macri ('Boll. Chim. Farm.'). While the reactions of $(NH_4)_2MoO_4$ with H_3PO_4 and H_2O_2, respectively, are sensitive and characteristic, H_2O_2 prevents the precipitation of NH_4 phosphomolybdate, coloring the solution intense yellow. The reaction of H_2O_2 and CrO_3 is not inhibited by the presence of H_2S, provided the CrO_3 solution is poured into the H_2O_2-H_2S solution. H_2O_2 in the presence of $CaCl_2$ and NH_4OH causes the formation of a white gelatinous precipitate, which increases with time, and finally changes to an amorphous, heavy, pulverulent deposit; this precipitate is composed of CaO_2 and is soluble in AcOH, from which it is not re-precipitated by addition of NH_4OH. When evaporating H_2O_2 in a platinum dish in the presence of HCl, H_2PtCl_6 is formed. H_2O_2 does not appreciably decompose $KMnO_4$ in the presence of HNO_3 (instead of H_2SO_4, HCl, etc.); decomposition, if it occurs, commences only after a considerable length of time; the decomposition proceeds more rapidly as the amount of $KMnO_4$ is increased. The amount of free acid (this method was only tested with H_2SO_4) in a H_2O_2 solution, may be determined by adding a standard solution of $KMnO_4$, with constant agitation of the acid H_2O_2 solution, until the latter assumes a brownish-yellow color. This determination is based on the fact that pure H_2O_2 does not decompose $KMnO_4$, and the amount of $KMnO_4$ decomposed by an acid solution of H_2O_2 is proportional to the amount of acid present. The content of acid may be calculated from the amount of $KMnO_4$ consumed, according to the equation:

$$2KMnO_4 + 5H_2O_2 + 3H_2SO_4 = K_2SO_4 + 2MnSO_4 + 5O_2 + 8H_2O$$

If the amount of acid present is very small the change in color is detected with difficulty. The addition of a small amount of $MgSO_4$ renders the color change more distinct.

Mexican Metal Production in 1917

The following statistics of metal production in Mexico for the year 1917, are furnished by the Statistical Section of the Department of Mines of the Republic. The quantities given are in kilogrammes (1 kg. = 2.2 lb.).

Gold

State	Kg.
Aguascalientes	652.000
Coahuila	365.000
Durango	161.313
Guanajuato	9.358
Hidalgo	1,855.707
Mexico	2,124.737
Nuevo Leon	289.623
Puebla	6.000
Sonora	240.234
Zacatecas	85.000
Total	5,788.972

Silver

State	Kg.
Aguascalientes	103,252.650
Coahuila	76,255.000
Durango	16,490.500
Guanajuato	744.000
Hidalgo	336,160.604
Mexico	14,588.189
Nuevo Leon	40,663.320
Puebla	85.000
Sonora	42,873.102
Zacatecas	17,572.000
Total	648,684.365

Copper

State	Kg.
Aguascalientes	4,371,297
Baja California	9,225,000
Coahuila	644,000
Nuevo Leon	31,089,484
Sonora	83,348,000
San Luis Potosi	565,590
Zacatecas	12,285,595
Total	141,528,966

Lead

State	Kg.
Aguascalientes	541,611
Coahuila	11,308,000
Durango	6,099,503
Nuevo Leon	7,523,252
Zacatecas	4,297,089
Total	29,769,455

Zinc

State	Kg.
Zacatecas	3,888,124

Antimony

State	Kg.
San Luis Potosi	2,140,590

The Use of Powdered Coal

By W. G. WILCOX

*Power and raw materials are the two factors that make up the balanced ration of industry. No matter how great our national resources, they will be of little value unless the power necessary for transportation, manufacturing, and fabrication is available. The greatest source of power is obtained through the combustion of fuels. Shortage of fuel at this time is so alarming as to call for the most careful consideration. The production scarcely equals the consumption. Concomitantly with the greatest demand for coal we have ever experienced we find the great natural gas-field of West Virginia failing alarmingly. This brings into the list of coal-consumers new users that were formerly dependent upon natural gas. At the same time fuel-oil is steadily becoming harder to obtain and almost prohibitive in cost. The oil-fired forge-furnaces of the East and the copper-reverberatories and cement-kilns of western Texas, Arizona, and Utah, the potash-producers of Nebraska, and the apartment-houses of Seattle are seeking supplies of coal. This means another new demand and a further burden on railroad transportation. As the railroads must have more coal in order to haul more coal the seriousness of the situation increases geometrically.

For this exigency there are three possible solutions:

1. Stimulation of the production and transportation of fuel.

2. Development of efficient methods for utilizing low-grade fuels hitherto practically unused.

3. Combustion of the fuel in so much more efficient a manner as to make the amount available adequate for all needs.

At best there does seem little reason to expect a great increase in production. Our largest opportunity for escape from the dilemma lies in the efficient combustion of both low-grade and high-grade fuels. It is far wiser to curtail avoidable losses than to compensate for them by increasing the supply. It is pre-eminently the patriotic and professional duty of the chemist and the engineer to work for the more efficient utilization of fuel. Among the more efficient methods of combustion is the use of powdered fuel. Assuming a good design of furnace and flue, and the proper draft, the essentials of good combustion for coal are:

1. Complete oxidation of all the combustible matter in the coal to avoid loss of combustibles in the ash and up the stack. The loss of unburned carbon will vary with different types of fuel, with different types of ash, and with the percentage of ash in the coal. It will also vary with the type of stoker used and the boiler-load carried. In hand-firing it will vary with the skill of the fireman; and in producer-operation it will vary according to the quality of the coal, the type of the producer, and the operating conditions.

Using an Illinois coal of the following analysis:

	%
Sulphur	5½
Volatile matter	34
Fixed carbon	42
Ash	18½

one of the large users in the Middle West records the following losses in ash:

	Actual per cent of coal lost
Over-feed stokers, 25% unburned carbon in the ash	4.6
Chain-grate stokers, 35lb unburned carbon in the ash	6.5
Hand-fired, 35% upward unburned carbon in the ash	6.5 and upward

This particular consumer has two different types of stokers and also does a large amount of hand-firing. His consumption is over 100 carloads of coal per day; operations are under the direction of skilled technical men.

In producer-operation, using a good-grade coal, 20% of unburned carbon in the ash is the minimum figure. Under bad conditions, when poor fine wet coal was used, and with variable steam-pressure, as high as 55% unburned carbon will be found in the ash even with a first-class modern producer.

With any type of stoker or producer the loss due to unburned carbon increases with the ash-content. Certain coals, although of high heating value, present enormous difficulties to efficient operation when put through a producer, or when burned on grates or on stokers. A case in point is a coal from south-western Virginia. This develops over 14,000 B.t.u. and contains under 8% ash; it shows fine laminations of pure calcite in amount sufficient to flux the other constituents of the ash and cause continuous trouble from clinkering.

Another case is a Colorado coal having the following proximate analysis:

	%
Ash	6.66
Volatile matter	43.76
Fixed carbon	49.58
Sulphur	0.93
B.t.u.	12,886

The ash melts, runs down the grates and freezes there, while the coal itself disintegrates, and chokes the fire.

*Paper read before the Western New York section of the American Chemical Society, May 31, 1918, by the Advisory Engineer to the Powdered Coal Engineering & Equipment Company, of Chicago.

2. Control of combustible and air. This is absolutely essential if we are to secure the maximum flame-temperature with a correspondingly increased rapidity of heat-transfer. The more rapid the transfer of heat in the furnace or boiler the higher the capacity of the furnace, and in general the greater the efficiency.

3. Control of flame-length. In order to maintain the conditions that the design of the furnace, the operation, or the metallurgical process, requires, it is essential that the length of the flame be under control. An example is found in a recent development in firing copper reverberatory furnaces. For a long time it has been the practice to fire such furnaces with an insufficient amount of air, admitting the amount required to complete combustion through ports in the side of the reverberatory. It has been found that if the number of oil-burners is increased, and the mixture of oil and air so adjusted as to give complete combustion with a short hot flame, the capacity of the furnace is increased in some cases as much as 50%, while the fuel ratio is greatly improved. This is also true of reverberatories fired with powdered coal. In this particular operation it has been found that a short hot flame leads to more efficient operation and increased capacity; but there are other processes in which the reverse is true.

In changing the fuel, for example, in turning from the hand-firing of coal to powdered-coal combustion, the economies are usually far greater than those that can be figured from the known losses. The increase in capacity is usually so great that it can only be attributed to the increased efficiency of the furnace. This may follow from the fact that the operator is enabled to maintain the flame-length and type of combustion for which that particular furnace is suited.

4. The method of combustion that is to be most efficient must possess flexibility in capacity. Flexibility in combustion means rapid response. Only in this way can a cold furnace be brought to heat quickly or a stand-by boiler come up to peak-load rapidly. This makes for efficiency because it reduces the fuel consumption during the stand-by period. Many operations also require variation in heat input at different stages; in order to secure the highest efficiency under these conditions, extreme flexibility as to 'combustion load' is demanded.

5. Control of the nature of the cumbustion. In many operations it is not only necessary to heat uniformly, quickly, and efficiently, but it is equally important to maintain a certain chemical condition in the atmosphere of the furnace. This may be oxidizing, reducing, or neutral. In any case the control of combustion should be such that the desired condition may be maintained within close limits; failure to do so means a waste of fuel. Maintaining an oxidizing condition without ability to control it within close limits will result in an excess of air, which will lower the flame-temperature, lessen the output, lower the furnace efficiency, and reduce the fuel-efficiency. Likewise a reducing condition, unless maintained within close limits, means that fuel is needlessly wasted. If the operation demand a neutral condition, there may be some loss due to the spoiling of the product, unless it be possible to maintain the neutral condition exactly.

6. One-stage combustion. The best example of two-stage combustion is the producer, which in many of its applications affords an over-all efficiency that is considerably higher than may be obtained by other methods. Nevertheless we should realize that in the process for making producer-gas there is an inherent loss of at least 20% because of the inability to gasify without forming a certain percentage of CO_2, due to heat-losses at the producer and losses in sensible heat from the gas between the producer and the point at which it is used.

There is another serious objection to two-stage combustion. When combustion is completed, the final flame-temperature is lower than in a one-stage process. Unless we resort to such devices as the recuperator or regenerator, high temperatures cannot be reached. Furthermore a two-stage combustion results in 'cracking' some of the most valuable constituents of the coal, with the formation of smoke in the furnace and soot in the producer. This has been shown by Kreisinger, Augustine, and Ovitz, in Bulletin No. 135 of the U. S. Bureau of Mines.

Having considered the essentials of combustion, we can estimate the value of powdered coal as a fuel. In the same way we can ascertain also the conditions demanded for success in the combustion of pulverized fuel.

The simplest view of the combustion of coal is to regard it as a reaction between fuel and oxygen. It is a heterogeneous system; consequently the velocity of the reaction and its completeness will depend upon the surface exposed by the solid, the pressure of the reacting gas, and the intimacy of the mixture. By grinding an inch cube of coal so fine that 85% will pass a 200-mesh screen, we have increased the surface exposure from six square inches to approximately 1800 sq. in. Thus we have increased the velocity of combustion 300-fold. By doing so, we have changed the characteristics of the fuel. We now have a fuel relatively 300 times more active than the inch cube of coal, a new type of fuel that has in it inherent possibilities not to be found in lump or slack fuel. By increasing the surface exposure 300-fold, we have speeded combustion proportionately. This carries with it a further effect. The increase in rapidity of combustion also increases the rapidity of heat evolution, and consequently quickly raises the temperature of the rest of the material. This rise of temperature, which is much more rapid than in the normal combustion of coal, will double the velocity of combustion for each rise of 10°C. The increased rapidity due to greater surface exposure and that due to temperature rise are superimposed so that a pulverized fuel affords a combustion that is hundreds of times faster than when burning lump-coal.

Having a finely-divided fuel it is possible to form a mixture of fuel and air so intimate that each small particle of coal is surrounded by the proper amount of air. In this condition, by maintaining the proper velocity of

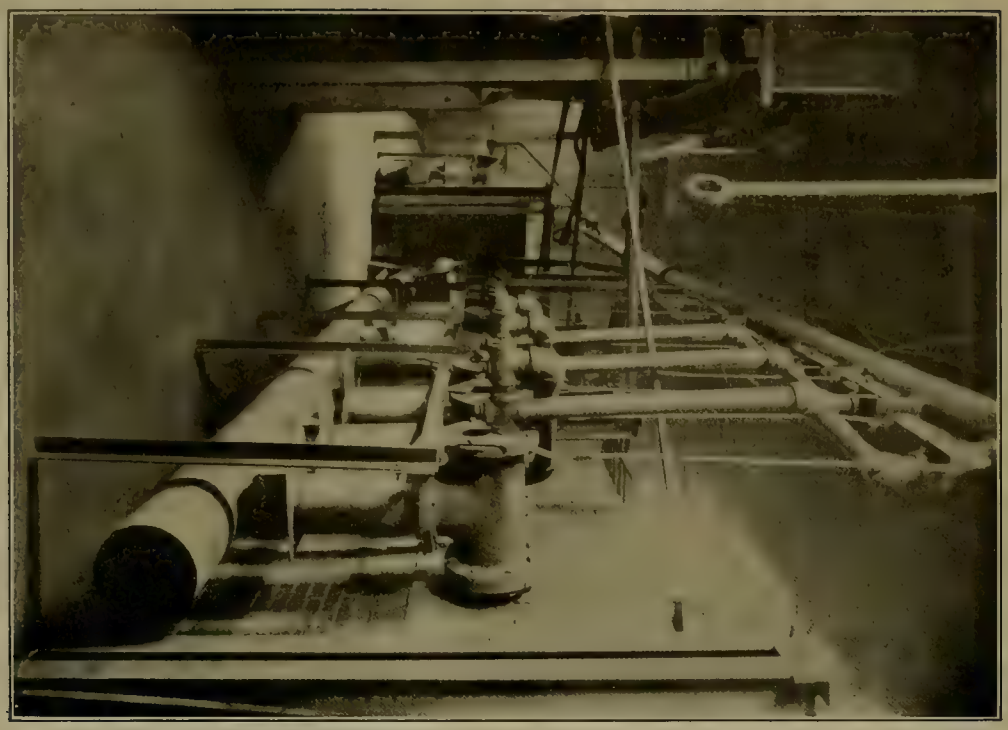
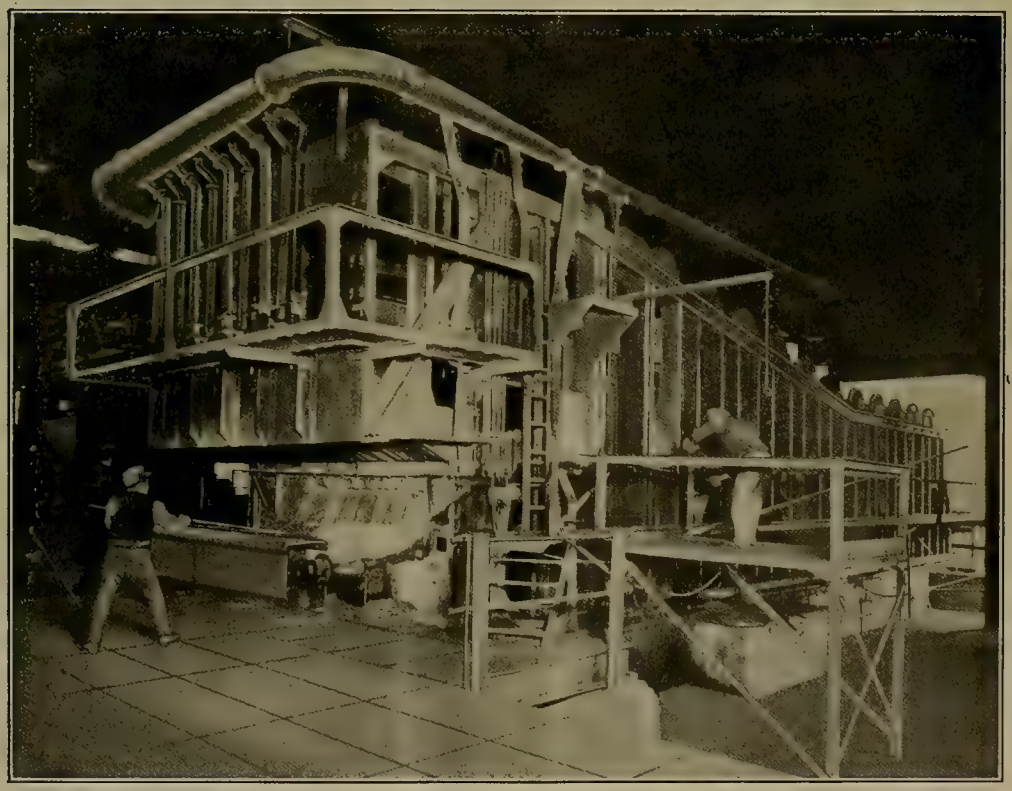


PLATE-HEATING FURNACE SHOWING POWDERED-COAL FEED-PIPE AND CONNECTIONS TO BURNERS



DISCHARGE END OF CONTINUOUS-BILLET HEATING-FURNACE

the air-current, the fuel can be carried into the furnace in suspension and there burned completely, efficiently, and rapidly.

It is, of course, a simple matter to mechanically control the amount of powdered coal delivered to the furnace in a given time. It is also possible to control the amount of air delivered with the coal. If, then, we deliver to the furnace an intimate mixture of air and powdered coal, and control the amount of coal-dust and air delivered, we have the prime essentials. The degree to which they are attained depends entirely upon how carefully we study the characteristics of the fuel before and during combustion.

The amount of coal-dust delivered can be controlled simply and positively by using a screw-feeder operated at variable speed. It is also a simple matter to control the volume of air admitted with the fuel; but the highest efficiency possible with this type of fuel will not be obtained unless we work out a correct way in which to mix a finely divided solid with the air.

A study of the methods for making such a mixture immediately shows that the methods commonly used in making a uniform mixture of two miscible liquids or a uniform solution of a solid in a liquid, or the methods used in mixing finely-ground solids are not only useless in this case, but will actually separate the coal-dust from the air. Ordinary mixing is done by agitation; this agitation is usually accomplished by baffling, stirring, shaking, or similar devices. When, however, such methods are applied to a mixture of gas and finely divided solid, the solid tends to separate by reason of its higher specific gravity. This, in fact, is the principle of the well-known cyclone dust-collector. Any mixing device that produces such agitation of the dust and air as to give a centrifugal effect will tend to separate, not mix, the air and the dust.

The importance of mixing the coal-dust and air intimately cannot be exaggerated. The rapidity of combustion is a direct measure of the intimacy of the mixture. This is well illustrated by comparing the ordinary gas-flame with the flame obtained in the Bone combustion system, which consists in forcing the proper proportion of air and gas through a diaphragm having numerous interstices. When this mixture is ignited on the other side of the diaphragm, it produces a film of flame.

The poorer the mixing, the longer the flame. The flame simply outlines the area in which combustion is taking place and the length of the flame is a measure of the time element necessary to accomplish combustion. This time element—other conditions being equal—is absolutely a function of the intimacy of mixture, as was noted by Breckenridge ten years ago, when in Bulletin No.325 of the U. S. Geological Survey, he stated:

"The conclusion is reached that the velocity of combustion decreases enormously from the surface of the fire to the rear of the combustion-chamber, where it is relatively very small, the practical application is that little is to be gained by adding further length of smooth combustion-chamber, which would be commercially as poor an investment of capital, as to add to the length of a Corliss engine-cylinder and stroke; we must resort to thorough mixing."

Just as in the past there has been a remarkable failure to realize the necessity for intimately mixing air and coal-dust, so there has been insufficient consideration of the characteristics of this fuel when burning. Powdered coal has the characteristics of a rich fuel of somewhat higher kindling temperature than producer-gas, natural gas, or fuel-oil. To illustrate the fact that it is a rich fuel, we can compare the available B.t.u. in a cubic foot of a correctly proportioned mixture of powdered coal and air and the available B.t.u. in a cubic foot of correctly proportioned mixture of pure methane and air. Take a Pittsburgh coal (heating value 14,157 B.t.u.) of the following analysis:

	%
Volatile	35.4
Fixed carbon	58.5
Ash	6.1

We find that a cubic foot of a correctly proportioned mixture of coal-dust and air has available 107 B.t.u., while a mixture of pure methane and the proper amount of air has available per cubic foot, 62.3 B.t.u.

The rapidity of combustion and the completeness of combustion of a mixture of coal-dust and air depend upon a number of factors: for example, they are dependent upon the velocity and pressure at which it is passed into the combustion-chamber. If the velocity of the incoming stream of powdered coal and air is above the velocity of flame propagation, combustion will not take place until the mixture has slowed down to a point that it does not exceed the velocity of flame propagation. When powdered coal is fired at high pressure and high velocity, combustion frequently does not begin until a point four to six feet from the mouth of the burner. A similar example is found in the plumber's blow-torch when too much air is used, or in the Bunsen burner when the gas-pressure is too high. High-pressure firing not only slows down combustion, thus increasing the size of the chamber necessary, but has a destructive action on the furnace. It has been well established that high velocities in the combustion-chamber or a blow-torch effect due to firing at high pressure (whether oil or gas be used as a fuel) are always destructive of the brickwork. This action is increased in high-pressure firing of powdered coal, since, in addition to the erosional effect of gases at high temperature traveling at high velocity, there is a fluxing action by the melted ash. Furthermore, the slagged ash will be carried along mechanically, leading to further furnace troubles. In one case this resulted in a deposit of slag on the mud-drum of a vertical waste-heat boiler at the end of a long reverberatory furnace. Slowing the velocity not only hastens combustion, but makes it possible to eliminate much of the slag. When the velocity is low the coalesced particles of slagged ash are either larger than will be carried by the velocity of the gas or this condition is so nearly approached that a slight change in direction of the flame will result in dropping out the slag. Thus, in addition to being correct com-

bustion and necessary in order to avoid excessive furnace-maintenance costs, low-velocity combustion, by a slight change in flame direction, permits the dropping out of a large quantity of the slagged ash in the early part of combustion, where it can be removed and will not interfere seriously with efficient metallurgical operations.

The velocity of combustion is not only dependent upon the fineness of the particles of coal, the intimacy of the mixture, and the velocity of the stream of combustible and air, but is affected by the temperature of the combustion-chamber. The kindling temperature of a mixture of powdered coal and air is higher than that of either oil or gas; consequently for successful and complete combustion, it is necessary that the combustion-chamber be maintained above a certain minimum temperature and that the combustion be practically completed before the products of combustion pass over the heat-absorbing surface. Just as you can extinguish a gas flame by passing over it a piece of wire-gauze, so the effect of a chilling surface will be even more marked with this combustible material than with burning gas, since the particle of coal is infinitely larger than a molecule of gas and the kindling temperature is also higher. This has a direct application to the successful firing of locomotive boilers, water-tube boilers, and return-tubular boilers. If the combustion of powdered coal be not sufficiently developed before the flame enters the tubes of the locomotive boiler, combustion will be checked and coked coal settle out in the tubes. If, on the other hand, combustion be sufficiently developed before the flame is brought in contact with the heat-absorbing surface, complete combustion and high efficiency are obtained.

A study of the flame developed at a low pressure by an intimate mixture of coal-dust and air shows that combustion is extremely rapid. In a copper-reverberatory furnace at Florence, Colorado, where this type of combustion is used, coal burned at the rate of approximately one ton an hour develops a flame that vanishes within six feet of the burner, combustion being complete at that point. Let us translate this into terms of natural gas, in which case the fuel consumption would be approximately 26,000 cu. ft. per hour or 433 cu. ft. per minute. You can picture to yourself this quantity of gas being burned at low pressure and developing a flame only six feet long. Samples of gas taken in the flame show a content of CO_2 as high as 16% only five feet from the mouth of the burner. This will give an example of the rapidity with which combustion can be obtained and the possibilities of shortening the flame. With proper equipment is is equally practicable to lengthen the flame until it will spindle out a distance as great as 100 or 120 ft. However, with an intimate mixture under control, this must be done by supplying insufficient air. Under such conditions combustion is incomplete and the flame spindles out because combustion continues to develop throughout the length of the furnace as air-leakage supplies additional oxygen. This is proof of the statement that the length of flame is an actual measure of efficiency of mixing and the adjustment of the fuel-air ratio.

Thus, it is seen that we have changed entirely the characteristics of coal as commonly known. Powdered coal is a fuel of extreme flexibility, in that the amount burned can be varied within wide limits. It is a fuel that develops a flame whose length can be adjusted. The character of the flame can be altered to suit the metallurgical operation. In short, the basic fuel, coal, has acquired the characteristics of oil or gas, but with better and closer control. Furthermore, the possibilities of this fuel are not only capable of realization, but are actually being utilized in commercial practice today. To the flame characteristics of a rich fuel, developing a flame like oil or gas, is added a degree of control not yet obtainable in burning either oil or gas. This statement is made advisedly. The possibilities of such combustion for the improvement of processes, for fuel economy, for increasing output, through its ease of control and elimination of heavy labor, are realized by few. Owing to the attitude of labor and the scarcity of skilled operatives, it is far more difficult than ever before to secure high efficiency and good operation in hand-firing, stoker-firing, or in producers, in short, whenever such efficiency depends upon constant watchfulness and hot, heavy, disagreeable work. For these conditions powdered coal substitutes an ease of control such that the equipment can be handled by an old man or a boy, while it is so simple that a man of ordinary intelligence can soon be taught all that is necessary for good efficiency in operation. The possibilities of such control in the place of present-day combustion methods, which permit high efficiency only by the most strenuous effort, through substituting for these a type of combustion whereby high efficiency is easily obtained, are certainly of great importance to us at the present time.

To those who are in touch with many diversified chemical industries, the possibility of maintaining and regulating heating conditions that are oxidizing, reducing, or neutral at will, conditions that once adjusted will remain constant—barring mechanical or electrical interruptions—will undoubtedly suggest many new economies and betterments.

THORIUM, according to R. B. Moore of the Bureau of Mines, is not in large demand at the present time. No domestic market exists, owing to the fact that the grade of the material so far discovered in this country does not hold up to the higher average of the Brazilian and Indian output. The South American product containing 6½% monazite, is worth about $300 per ton. The only purchasers in this country are the Welsbach Co., Gloucester City, New Jersey, the Lindsay Light Co., of Chicago, and the Block Co. of the same place.

SULPHUR in Germany is being obtained at the present time almost exclusively by the reduction of gypsum. It is reported that deposits of anhydrite are similarly being utilized.

Electric Welding Tests for Ship Construction

Final arrangements have been made for a series of extensive tests covering the use of electric welding in ship construction at the works of the Federal Shipbuilding Corporation, Kearny, near Newark, New Jersey. As a basis for the general adoption of spot and arc welding in the construction of steel vessels, a typical 40-ft. hull, exactly similar to those now being built at the plant, will be assembled by the new method. Following initial investigations, it is pointed out that this process gives evidence of effecting great economy in time and money over the methods now regularly used, and moreover, affords particular flexibility for adoption in the building of the heavy type of steel ships. It is estimated that it will be possible to save a month's time in the construction of a 10,000-ton vessel, as well as about $40 per ton in the cost of the steel structure, making a total saving of approximately $100,000 on a ship of this size. The factors considered in these estimates include the elimination or the minimizing of the work of the template-maker and marker, fitters and bolters, the punching of holes and, where the rolling-mill and fabricating shop are not in the same yard, the transportation of material between the two plants.

In carrying out these tests, it is proposed to make the initial assembling of the hull by spot welding, bringing the work to a point where the vessel is sufficiently strong to hold its shape. The subsequent operations will be handled by the arc-welding process, making the seams of adequate strength and water-tight. On the test hull, three-quarters of the structure will be welded and one-quarter riveted to allow a basis for comparison in placing the work under tests for pressure and strength. The primary test will consist of filling the hull with water and shifting the points of support, followed by bumping with rams, and subjecting it to other abuses, to determine the capability of the finished hull. The tests will be conducted by Arthur J. Mason of the New York office of the U. S. Shipping Board, who, in a preliminary report to Charles Piez, vice-president of the Emergency Fleet Corporation, points out that only about one-fifth of the men working on a steel hull under the present system of construction are riveters, the other four-fifths being engaged in flogging and pulling the frame together by bolts. The spot weld, it is stated, will prove a much more vigorous agency for accomplishing this purpose. The problem of fitting in place the parts of a hull are almost wholly those arising from the necessity of making a number of small holes in a plate by one man at a time, and fitting a number of small holes made by another man at another time and place. By the welding process, all holes are left out of the material, all the parts fit, and creeping and kindred difficulties disappear.

QUOTATIONS on sulphuric acid at Baltimore at the end of May were $25 per ton for 60°B., and $40 for 66°. No free offerings of acid are being made by manufacturers.

Reducing Zinc Loss in Brass-Making

The Bureau of Mines has developed a type of electric melting-furnace that may revolutionize the melting of brass. Patents on this furnace, which is known as the rocking electric furnace, have been taken out by the Bureau and assigned to the Secretary of the Interior as trustee. Free licenses to operate these furnaces under patents can be obtained by applying to the Director of the Bureau of Mines. This furnace is the result of five years experimentation by H. W. Gillett, chemist of the Bureau of Mines, in co-operation with the laboratory of Cornell University, the American Institute of Metals, and numerous manufacturers of brass. Brass is usually made in costly crucibles of imported clay and graphite. Since the War began it has been impossible to obtain these materials in sufficient abundance, and manufacturers have had to use crucibles of poorer quality, and at a larger cost. With the huge tonnage of brass needed for war purposes, such as shells for cartridges, manufacturers have been anxious to obtain a solution of the problem. The Bureau states that electric furnaces will largely replace crucible furnaces and that there will be a development comparable to that seen in the steel industry in the last few years. The electric furnace will greatly decrease the loss of zinc in the process of brass-making. Zinc boils at a much lower temperature than copper, and there have consequently been large losses in the open-crucible furnace through volatilization. The electric furnace is closed and these losses are avoided. It is estimated that the unnecessary loss in brass-making is more than $3,000,000 per year in normal times and perhaps at the rate of $10,000,000 per year at present. Another claim made for the electric furnace is that the working conditions for the men are more healthful. The Michigan Smelting & Refining Co., Detroit, Michigan, has one of these furnaces in operation and four more under construction, while the C. B. Bohn Foundry Co., also of Detroit, is building two furnaces.

NITROGEN fixation by the Reid process, which has been favorably reported upon by the Government, is accomplished by producing carbide through first coking a mixture of ground coal and lime, and reducing the lime-coke thus formed in a type of electric furnace that permits of the use of 'off-peak' power. Such power can be had at low rates. The Reid process nitrifies the carbide at a lower temperature than the cyanamid method, and by the use of a catalyzer reduces the lime required for nitrification. The cyanamid produced gives off its fixed nitrogen in the form of ammonia on treating it with waste or moist steam.

GRAPHITE crucible manufacturers are said to require 30,000 tons of graphite this year, and if transportation can be had a market exists for about 8000 tons more flake graphite than now is in sight. According to the Department of Commerce the imports of graphite in 1917 amounted to 42,609 short tons, valued at $8,961,988.

Hand-Sorting of Mill-Feed

By R. S. HANDY

*Does hand-sorting of mill-feed pay? The fact that the practice is so general would seem to indicate that there must be good reasons for it; yet, to my mind, the advantage in many cases is doubtful enough to invite a thorough discussion, in an effort to determine under what conditions hand-sorting does pay.

A typical sorting-plant in the Coeur d'Alene region handles about 800 tons of mine-run ore per day. The material is run over a grizzly with a 4-in. opening; the oversize is crushed to 4-in. size and joins the undersize, and the whole product is washed and screened on trommels with 1½-in. openings. The oversize from these trommels is spread on a belt and the waste and first-class ore are sorted out by hand, the residue being further crushed,

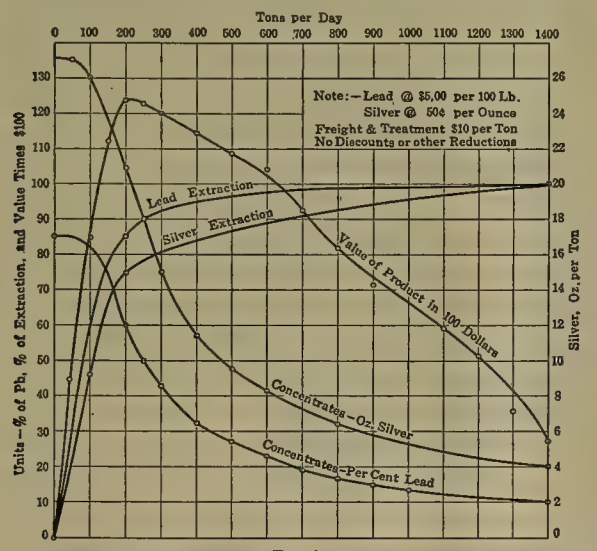


FIG. 1.

to pass, together with the trommel undersize, into the mill-feed bins.

About 50 tons of shipping ore and 150 tons of waste are sorted out per day, leaving about 600 tons of mill-feed. To sort out this material requires 20 sorters with five bosses and repair-men. The normal cost of hand-sorting is about 16c. per ton of run-of-mine, or 65c. per ton of material sorted. I believe that straight crushing and milling of the run-of-mine, in this case, is not only cheaper, but is metallurgically more effective than hand-sorting followed by milling of the residue.

At one of the Bunker Hill rock-houses, 1250 tons of run-of-mine are reduced to pass 30-mm., or about 1¼-in. opening in six hours, requiring five men. The equipment and the power consumed are not greatly different from those required in a sorting-plant of the same capacity, and the normal cost of thus preparing the feed for milling is under 3c. per ton of mine-product. The relative cheapness of this method as against hand-sorting is thus clearly established, the saving being about 13c. per ton. If there is any virtue in hand-sorting, then, it must lie in the metallurgical results achieved.

Possibly the favor that hand-sorting has found is due to a misconception as to what happens to the clean shipping ore if it is sent to the mill. If a mill makes, say,

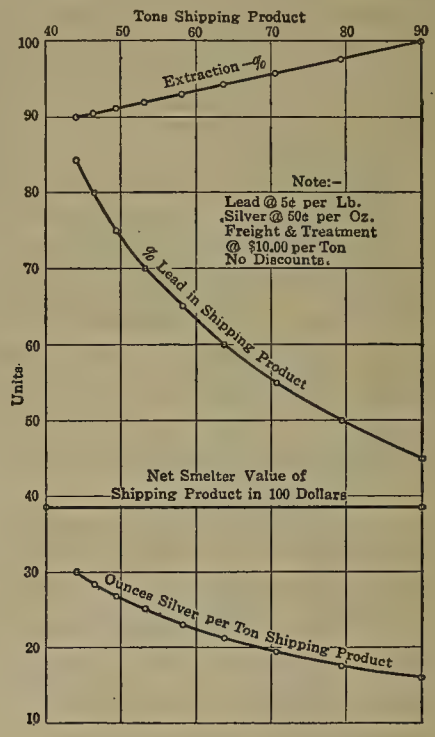


FIG. 2.

an 80% recovery on its feed, the advocate of hand-sorting may assume that if the hand-sorted product be sent to the mill, 20% of the valuable metals will be lost. This, I believe, is a false assumption. There is no ore of shipping grade getting past the first two cups of the jigs in the Bunker Hill mill, down to at least 7 mm. in size, and very little gets into the middlings in the sizes below 7 mm. Of course, none gets into the tailings. The only loss, then, in milling the hand-sorted product must be the losses due to sliming in the crushing operation and the slime lost on account of attrition of the soft galena in the jig-beds. Crushing through 1½-in., in our experi-

*Trans. A. I. M. E., to be read at the Colorado meeting, September 1918.

ence, produces less than 2% of material below 40-mesh and the saving on this product nowadays is practically the same as on the coarser material.

I have tested our jigs time and again for slime losses, and have found that the slime in the tailings of all the jigs down to 7 mm. size, including those from the re-concentrating jigs, does not exceed 0.1%, by weight, of the tailings. This slime assays about the same as the mill-feed. Attributing the whole of this slime loss to the 50 tons of hand-sorted ore in the sorting-plant mentioned would account for the loss of about 50 lb. of lead per day, against which is the cost of $30 or $40 per day for sorting.

Our bull-jigs, treating material between 1¼ and 1½ in., make no shipping product—only middling, which is crushed through rolls and re-concentrated, and tailing. Therefore, there are no smooth, worn 'marbles' of galena in the beds of our bull-jigs, such as occur when jigs are forced to produce a higher-grade product than the conditions warrant. For example, if we try to make a shipping product in our bull-jigs, about the best grade we can get is 55% lead, and under these conditions there is considerable wear of the soft material on the jig-beds. By taking off a middling product assaying about 25% lead, and crushing and re-jigging this, we can easily produce a concentrate in the re-concentrating jigs assaying 65% lead with very little wear on the bed.

Considering the slight mechanical losses that occur in milling the hand-sorted ore, there is little to be said in favor of hand-sorting from this standpoint.

If there is no advantage in sorting a shipping product, there must be less advantage in sorting waste, when the cost is 50 or 60c. per ton of waste rejected. Each of our bull-jigs will treat 150 tons of feed per 24 hours and throw off 90 tons of tailing assaying less than 0.4% lead. I am satisfied that a jig handling larger sizes and designed primarily to discard tailing could throw off waste of lower grade and do it much cheaper than any method of hand-sorting in use.

There is an economical advantage in the milling of ore as against hand-sorting. This is in the grading of the products, as is illustrated in the accompanying chart, Fig. 1. Beginning at the left, a curve is drawn showing the net smelter-value of mill-product derived from conditions shown in the other curves. The top scale indicates the tons of product shipped, and the scales on the left and right indicate the units on the curves. For example, if 1400 tons of product (or the mill-feed, assaying 10% lead and 4 oz. silver per ton) are shipped to the smelter under the conditions stated in the note, the recovery of lead and silver is 100% and the net smelter-value is $2800. If nothing but the clean galena is shipped, about 50 tons can be produced, assaying 86% lead and 26 oz. of silver. The recovery of lead would be about 30% and the net smelter-value of the product would be $4500. If a concentrate assaying 33% lead were produced, a recovery of 95% of the lead and 84% of the silver would have to be obtained to get the same net smelter-value in the product as that recovered when the grade of the product is 60% lead and the recovery 85% of the lead and 75% of the silver. The latter condition seems to be the most economical under the conditions stated. That is, there seems to be a definite economic peak in the milling of ores where the various factors of recovery, grade, and cost combine to give a maximum net value, or money return, to the operator.

When hand-sorting was practised at the Bunker Hill plant, it was not practicable to sort out a product containing over 45% lead, and I understand the average grade was less than that. In order to estimate the possibilities of hand-sorting at the Bunker Hill plant under the conditions existing at the sorting plant first mentioned, I have used 45% lead and 16 oz. of silver for the hand-sorted product and the economic relationships in the various treatments possible for this product have been indicated graphically in Fig. 2. This is based on a production of 90 tons per day of hand-sorted shipping product, which would be the Bunker Hill production under the conditions stated. The net smelter-value of these 90 tons, under the conditions stated on the note in the chart, would be $3870 and the recovery of the metals, from a milling standpoint, would be 100%. If this material were milled and a concentrate produced containing 84% lead and 29.8 oz. of silver, 43.5 tons of such concentrate would have to be produced to equal the net smelter-value of the original ore. This would mean a recovery of the metals of 90% and the discarding of 46.5 tons of tailing assaying 8.5% lead and 3.1 oz. of silver. If the grade of the concentrate produced is 60% lead and 21 oz. of silver per ton, the recovery is about 94% and 26.5 tons of tailing is produced assaying the same as before. The production of a concentrate, from the treatment of this material, assaying 60 or even 70% lead would be an easy thing to do, but I think it would not be necessary to discard a tailing assaying over 8% lead in producing this concentrate. In fact, it could probably be done with a tailing running less than 2% lead, in which event the economic advantage over hand-sorting would be very large.

The crux of the whole matter is, "What can you do with the hand-sorted product in the mill;" and not, "What does the mill do on the feed it is getting?" The only sure test is to run the mill on a hand-sorted product long enough to determine what grade of concentrate and of tailing can be achieved. I am sure a test of this kind would surprise many of the advocates of hand-sorting by demonstrating the enormous economic advantage to be gained by the opposite method of treatment.

ELECTRO-CHEMICAL separation of tin from other metals is proposed by Leon-Charles Delahaye in a French patent, No. 484,148, issued September 7, 1917. The tin is deposited from an electrolyte consisting of $NaPO_3$, Na_2SO_4, NaCl, Na_2CO_3, preferably in the proportions for 100 litres of H_2O, of 12, 10, 10, and 2 kg., respectively, using crystallized Na_2SO_4 and dry Na_2CO_3. The current density should be about 150 amp. per sq. m. of the cathode, and the voltage should vary, during the electrolysis, from 3 at first to 4 to 5 volts toward the last. The best results are obtained at a temperature of about 95° Centigrade.

The Geology and Ore Deposits of Ely, Nevada

By ARTHUR C. SPENCER. Prècis by JOHN B. HASTINGS

*Structural Geology. The Ely quadrangle is in the Great Basin area of eastern Nevada, which is characterized generally by long north and south mountain ranges and intervening valleys, each five to ten miles wide, and as much as 140 miles long. These ranges are late Tertiary areas of elevation and depression.

The district may be regarded as a shallow north-south syncline, with rude flanking arches, disturbed by unsystematic dislocation from early to late geologic time, contrasting with the orderly north-south faults determining the larger topographic structure. The syncline is something like the depression made by the body in a bed and the higher sides and presumably on the edges of the bed-faults marking the eastern and western scarps of the range. The exposed sedimentaries forming the area are: Carboniferous, Pennsylvanian, the Arcturus limestone, exposed 400 ft., Ely limestone 2500 ft.; Mississippian, the Chainman shale 250 ft., Joanna limestone 100-400, Pilot shale 200; Devonian, the Nevada limestone 4000; Ordivician, the Eureka quartzite 150 ft., and the Pogonip limestone, exposed 1400 ft. They have been greatly disturbed by faulting, and to a less extent by folding, so their areal distribution is very irregular. Since the close of the Carboniferous it has been a land area.

Monzonite Intrusion. The six uppermost of the eight formations in one place or another have been invaded by monzonite porphyry. The intrusion of the monzonite, one-half to one mile wide by seven miles long, from east to west across the syncline, occurred at the close of the Jurassic, or post-Jurassic, and though the rock may differ in appearance and composition, it is thought, from the latest mine development, that it all belongs to a single igneous epoch.

Alteration of the Rocks. The heat and the emanations from the intrusions altered the adjacent sedimentaries for a few hundred to 2500 ft. from the contact, the effect decreasing with remoteness. Finally, after cooling and crystallization, the monzonite was itself metamorphosed and mineralized, by continued ascent of solutions, especially along a wide middle band. These solutions, from first to last, introduced silica, sulphur, iron, and potassium, also copper, lead, zinc, gold, and silver, more of the latter minerals into the porphyry in the final stages than previously into the sedimentaries. Carbon di-oxide is believed to have been plentifully present, but if the solutions were originally acid through attacking the rocks they would become alkaline or neutral and then deposition of the metallic minerals would take place.

*Abstract from U. S. G. S., Prof. Paper No. 96, 1917.

Alteration of the limestone consisted principally of one simple crystallization and the loss of carbonaceous blue and black coloring, making a fine-grained marble; of metasomatic replacement by quartz and sometimes chalcedony, yielding jasperoid, presenting prominent rusty outcrops; of development of lime-bearing silicate minerals, commonly garnet and tremolite, but also white and brown mica, pyroxene, epidote, and scapolite; and of the formation of pyrite and pyrite-magnetite bodies, with some pyrrhotite, chalcopyrite, sphalerite, galena, molybdenite, and hematite. The altered limestone, shale, and porphyry are all impregnated with 2 to 10% pyrite, and with chalcopyrite from nearly nothing upward. The shale altered to pyritiferous hornstone. Microscopically they show felty or finely granular wollastonite, epidote, calcite, pyrite, and magnetite. Sometimes pyrite was introduced synchronously with pyritization of the monzonite.

In the monzonite alteration, much of the rock was greatly seamed by quartz and sulphide-bearing veinlets, or by films of pyrite; but other portions are quite or nearly free from such filling, yet both kinds of material are thoroughly altered in bulk, and are generally highly impregnated with pyrite, accompanied by chalcopyrite. The solutions that caused the alteration penetrated so deeply that after being metamorphosed large masses of porphyry, essentially lacking in fracture-filling, carried chalcopyrite in such quantities that a slight enrichment has been adequate for their conversion into commercial ores. However, the content of chalcopyrite in the metamorphosed porphyry is ordinarily higher where the rock was considerably crushed and filled with quartz prior to its complete alteration than when the only alterations were those due to permeation into the rock. Perhaps also the rock-minerals have undergone somewhat more complete alterations where vein-stuff occurs than elsewhere. All things considered, the order of the mineralization seems to have been: (1) permeation of the rock by solutions capable of producing alteration; (2) formation of veinlets, usually of quartz, or of quartz with a little orthoclase and biotite, carrying distributed pyrite and chalcopyrite. Some of the veinlets carry a medial film of pyrite; (3) the deposition of pyrite films in joint-fractures. These three sorts of mineralization may be observed together in material from the open pits of the Nevada Consolidated Co., from the Butte-Ely shaft, and from the porphyry mine of the Giroux Co. In other material from the same localities, and from the Veteran mine, the first and second alterations are noted without the third; in material from Weary Flat and from the Eureka shaft on the Ely Central property, the second

and third alterations are most prominent, and in material from the McDonald-Ely shafts in the eastern part of the district alterations which seem to be related to the third class are mainly in evidence. The alterations of the porphyry, which are of the greatest interest in the formation of copper ores of the disseminated type, are those that have been produced through the permeation of the rock-mass by magmatic solutions. These alterations comprise, in different stages, the progressive destruction of hornblende, of plagioclase, and of magnetite, and the formation in their stead of mica, including the white variety of felty habit commonly called sericite, and a brown variety allied to biotite, the deposition of pyrite and chalcopyrite, and also of calcite. Pyrite and chalcopyrite occur mainly in the altered ground-mass, but are also found in the sericitic aggregates and rarely in the large orthoclase crystals. The ground-mass of the thoroughly altered porphyry has a granulated appearance quite distinct from that of the normal rock. In extreme alteration the rock is a felt of sericite flecked with grains of sulphide and of quartz.

Late Vulcanism. In the Tertiary, probably in Pliocene time, vulcanism was again active in north-east Nevada, and though little has withstood erosion, tuffs and rhyolite probably covered nearly the whole Ely quadrangle. White to gray fragmentary tuffs, evidently from explosive eruptions, occur in the rhyolite area north of Lane valley, between the upper part of Robinson canyon and Lyon spring; they have been quarried for building purposes one-half mile west of Keystone, where the railroad leaves the canyon, and between Ruth village and Copper Flat. Black obsidian overlies the tuffs north of Lane valley and near the railroad spur west of Star Pointer. Lastly older and younger rhyolites were extruded, being purple or red massive rocks with grains of black quartz and sanadine phenocrysts, west of Liberty pit, between Copper Flat and Star Pointer, and north of Lane valley, while lighter colored, platy, fluidal rocks, are also found north of Lane valley and on the north side of Keystone hill. The former older flows are known, which are as much as 468 ft. thick, as demonstrated in the Eureka shaft of the Ely Central, while the later flows may be 300 feet.

Quaternary Climatic Conditions. The Quaternary was marked by alternating wet and dry climates over Nevada, Utah, and Idaho, evidenced by the formation of all of the great geologic lakes, of which Salt Lake is now a diminutive remnant. Once it was 800 ft. deeper than at present, and extended to within 30 miles of Ely. This prehistoric enlargement is designated Lake Bonneville. The dry and wet changes are: (1) pre-Lake Bonneville epoch, characterized by an arid climate, and marked by an accumulation of alluvial deposits, which flank the mountain masses; (2) first flooding of the basin as a result of increased humidity; (3) dessication from aridity of climate; (4) second flooding, indicating humidity; (5) present epoch of aridity. During the first the alluvial cone was dropped at the mouth of Steptoe creek, there being insufficient water to carry it farther; in the second the creek was larger and, cutting through the cone, distributed its load in the lower valley; the third was not quite so dry as the first, and its cone, more widely spread, was formed farther out in the valley, and has since been obliterated by erosion and further deposition. However, traces of changes corresponding to the third, fourth, and fifth are not quite definite. Steptoe cone is terraced 150 to 40 ft. above the present flood-plain, the upper bench probably resulting from the lateral erosion of a perennial stream during the second, and the lower bench the same during the fourth and fifth stages. The present dry climate is reflected by the clogged condition of Robinson valley below Keystone, where loose debris fills the channel to depths of 30 to 80 ft., and also in the conical piles of alluvium at the mouth of steep side gulches.

Origin of the Chalcocite or Secondary Enrichment. Metallic sulphides are easily decomposed by oxygenated waters, but the amount of oxygen the Ely mine water could carry downward would not be sufficient during the age of the earth to affect the amount of oxidation that has taken place. As this really has transpired other explanations must be sought. The first step is the easy circulation of air through the porous capping, continually replacing oxygen depleted from the descending percolating waters. The incomplete oxidation thus effected is indicated by Gottschalk and Buehler, changing the pyrite into ferrous sulphate, sulphur, and sulphur dioxide. Oxidation by free oxygen takes place as follows:

(C) $FeS_2 + 4O = FeSO_4 + S$

(D) $FeS_2 + 6O = FeSO_4 + SO_2$

With water and a higher oxidation into ferric sulphate, with generation of sulphuric acid, the reactions would be:

(1) $FeS_2 + 7O + H_2O = FeSO_4 + H_2SO_4$

(2) $2FeSO_4 + O + H_2SO_4 = Fe_2(SO_4)_3 + H_2O$

Then, from (1) and (2):

(3) $2FeS_2 + 15O + H_2O = Fe_2(SO_4)_3 + H_2SO_4$

For chalcopyrite, analagous to (1) and (2):

(1a) $CuFeS_2 + 8O = FeSO_4 + CuS_4O$

(3a) $2CuFeS_2 + 17O + H_2SO_4 = Fe_2(SO_4)_3 + 2CuSO_4 + H_2O$

Part of the ferric sulphate formed decomposes to basic iron sulphates and hydrated iron oxide.

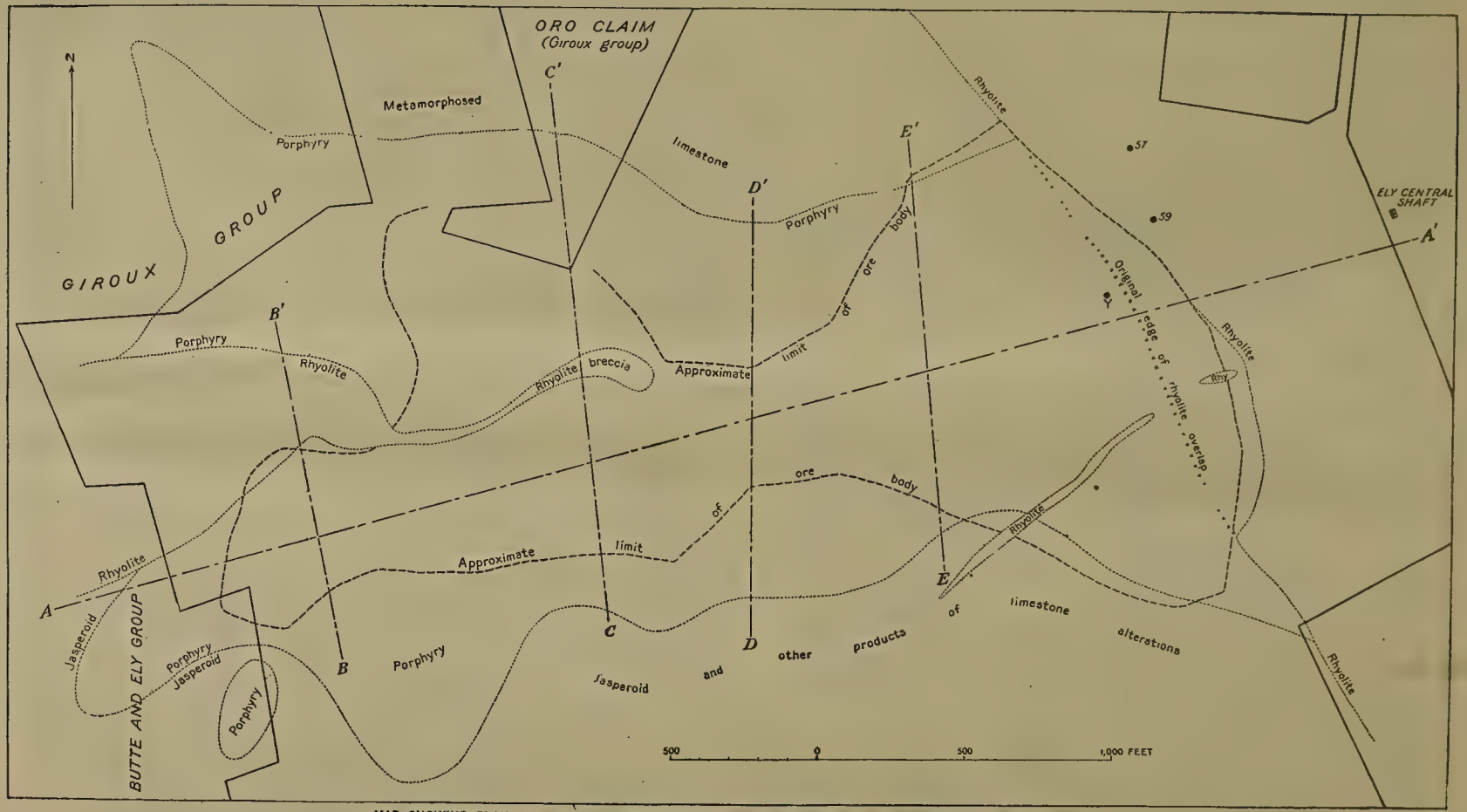
$$6FeSO_4 + 3O + 3H_2O = 2Fe_2(SO_4)_3 + 2Fe(OH)_3$$

and part may descend to attack pyrite, chalcopyrite, and chalcocite.

The descending sulphuric acid and ferric sulphate solutions quickly encounter chalcocite, and if free oxygen remains chalcocite is decomposed into cupric sulphate.

(4) $Cu_2S + H_2SO_4 + 5O = 2CuSO_4 + H_2O$

It may be assumed this uses the last of the free oxygen,



MAP SHOWING PLAN OF ORE BODY AND AREAL EXTENT OF PORPHYRY IN COPPER FLAT-LIBERTY MINE.
Data in part from annual report of Nevada Consolidated Copper Co. for 1913. *A–A'*, etc., Lines of sections shown in Plate XII

but ferric and cupric sulphates remain, both capable of oxidizing sulphides; the ferric being more easily reduced might almost all become ferrous before the cupric became an oxidizing agent.

Oxidation by Ferric Sulphate. Where chalcocite and other sulphides occur together, especially as at Ely, where chalcocite coats pyrite and chalcopyrite, chalcocite is the first mineral attacked, and protects the others. Vogt gives an equation for the change of ferric sulphate and chalcocite into ferrous and cupric sulphates:

$$(5)\quad Cu_2S + 2Fe_2(SO_4)_3 = 4FeSO_4 + 2CuSO_4 + S$$

Sulphur might react with more ferric sulphate and form sulphur dioxide (7), and dioxide with more ferric and produce sulphuric acid (8), leading to an equation of Weed's:

$$(5a)\quad Cu_2S + 5Fe_2(SO_4)_3 + 4H_2O = 10FeSO_4 + 4H_2SO_4 + 2CuSO_4$$

(5a) may be regarded as summarizing the following steps in oxidation:

$$Cu_2S + Fe_2(SO_4)_3 = CuS + 2FeSO_4 + CuSO_4$$
$$CuS + Fe_2(SO_4)_3 = S + 2FeSO_4 + CuSO_4$$
$$S + Fe_2(SO_4)_3 = 2SO_2 + 2FeSO_4$$
$$2SO_2 + 2Fe_2(SO_4)_3 + 4H_2O = 4FeSO_4 + 4H_2SO_4$$

Ferric sulphate may be considered as acting on pyrite about as follows (6), (7), and (8) leading up to (9), and (9) comparable to (1).

$$(6)\quad FeS_2 + Fe_2(SO_4)_3 = 3FeSO_4 + 2S$$

$$(7)\quad S + Fe_2(SO_4)_3 = 2FeSO_4 + 2SO_2$$

$$(8)\quad SO_2 + Fe_2(SO_4)_3 + 2H_2O = 2FeSO_4 + 2H_2SO_4$$

$$(9)\quad FeS_2 + 7Fe_2(SO_4)_3 + 8H_2O = 15FeSO_4 + 8H_2SO_4$$

For chalcopyrite an expression similar to (9) is:

$$(9a)\quad CuFeS_2 + 8Fe_2(SO_4)_3 + 8H_2O = 17FeSO_4 + CuSO_4 + 8H_2SO_4$$

After allowing for great irregularities in the under surface of the oxidized capping in contact with the subjacent ore due to fractures in the latter, in which occasionally the chalcocite appears unattacked, the decomposing power of the downward moving waters, as dependent on free oxygen, appears generally to be spent in a shell of, say, 3 ft. thick, though impoverishment may continue considerably deeper through ferric sulphate reacting on chalcocite, as in (5) and (5a).

Therefore it may be concluded: (1) so long as descending surface waters can acquire free oxygen, or contain ferric sulphate, they will strongly decompose metallic sulphides; (2) where chalcocite, pyrite, and chalcopyrite are present, chalcocite will be largely, perhaps fully, decomposed before the others are attacked; (3) the decomposition of chalcocite, chalcopyrite, and pyrite reduces the ferric salts; (4) their decomposition tends to produce sulphuric acid; (5) decomposition of chalcocite and chalcopyrite furnish cupric sulphate.

Oxidation by Cupric Sulphate. The descending waters do not now contain free oxygen and very little ferric sulphate, but they carry ferrous and cupric sulphates and sulphuric acid. The cupric sulphate survives because at ordinary temperatures, and in acid solution, it is less readily reduced than ferrous sulphate. Dilute sulphuric acid at ordinary temperatures without oxygen does not decompose chalcocite, and probably does not attack chalcopyrite or pyrite. Cupric sulphate, at high temperatures, reacts with chalcocite to form covellite and cuprous sulphate, and the former, on cooling, decomposes, precipitating metallic copper. Cupric sulphate attacks chalcopyrite and pyrite at ordinary temperature, forming ferrous sulphate and sulphuric acid, and a copper sulphide is deposited.

The suggested equations are: pyrite to chalcocite through cupric sulphate, as:

$$2FeS_2 + 2CuSO_4 = Cu_2S + 2FeSO_4 + 3S$$
$$3S + 2CuSO_4 = Cu_2S + 4SO_2$$
$$5SO_2 + 2CuSO_4 + 6H_2O = Cu_2S + 6H_2SO_4$$

$$(10)\quad 5FeS_2 + 14CuSO_4 + 12H_2O = 7Cu_2S + 5FeSO_4 + 12H_2SO_4$$

Next, pyrite to covellite:

$$(11)\quad 4FeS_2 + 7CuSO_4 + 4H_2O = 7CuS + 4FeSO_4 + 4H_2SO_4$$

And pyrite to chalcopyrite:

$$(12)\quad 8FeS_2 + 7CuSO_4 + 8H_2O = 7CuFeS_2 + FeSO_4 + 8H_2SO_4$$

These complete reactions may require steps through minerals intermediate between pyrite and chalcopyrite and between chalcopyrite and chalcocite.

A summary of equations, from chalcopyrite to chalcocite and to covellite, analagous to (10) and (11), is:

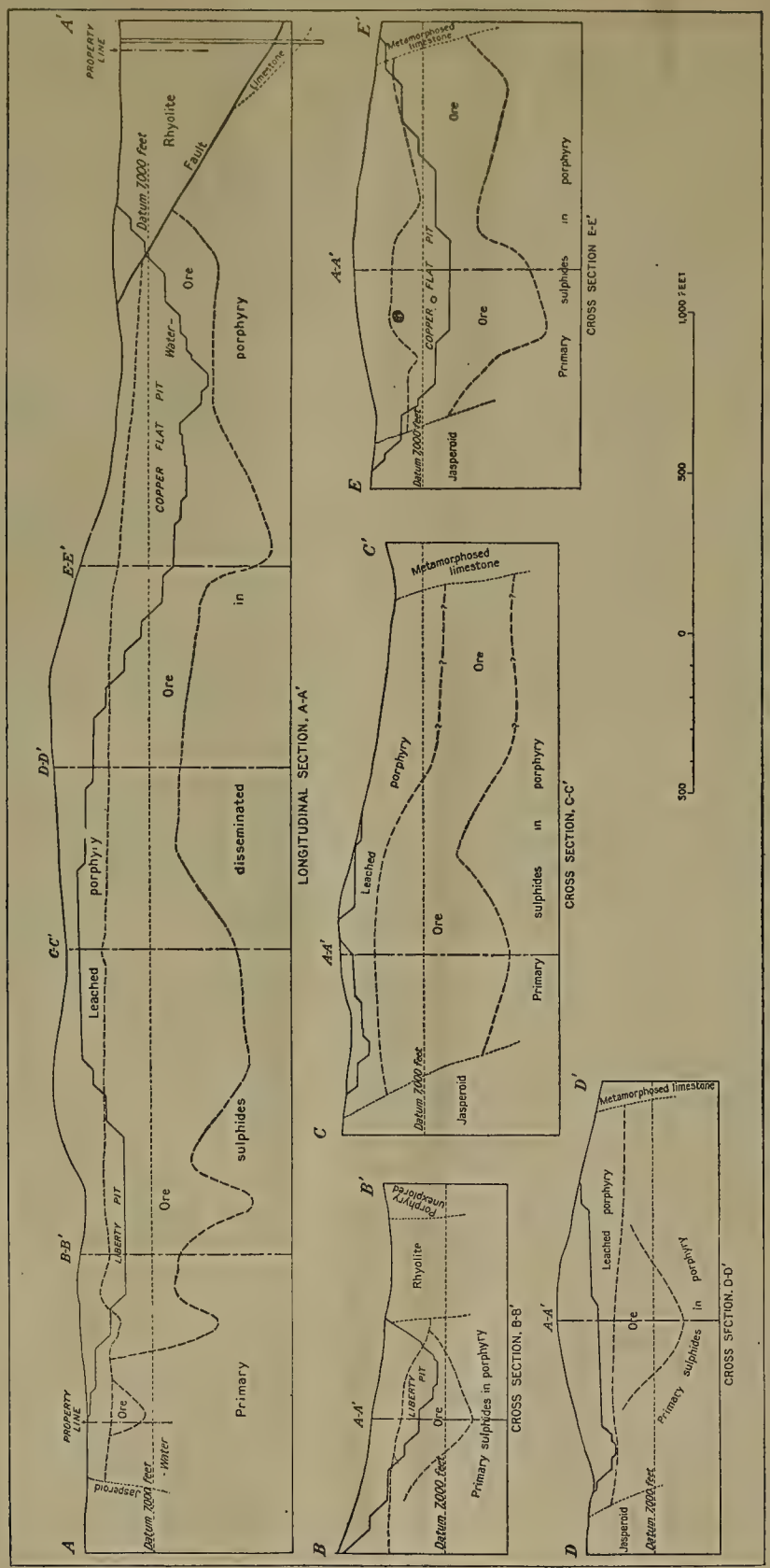
$$(13)\quad 5CuFeS_2 + 11CuSO_4 + 8H_2O = 8Cu_2S + 5FeSO_4 + 8H_2SO_4$$

$$(14)\quad CuFeS_2 + CuSO_4 = 2CuS + FeSO_4$$

Detailed examinations of polished surfaces and thin sections show that in the Ely mines, though chalcocite replaces pyrite, if chalcopyrite is present it is the mineral mostly affected.

Geologic Age of the Chalcocite Enrichment. The transfer of copper from the upper to the lower portions of the porphyry, as described, has kept pace with the erosion of hundreds, perhaps thousands, of feet of the intrusion, but probably the erupted Pliocene rhyolites covered the ore-belt, making a long interval of abeyance during its removal, and there has been little erosion since the beginning of the pre-Lake Bonneville epoch; therefore it is judged that practically all the secondary copper of the present enriched orebodies is due to conditions during late Pliocene time, but re-distribution of the metal has been going on since then, gradually lowering the top of the orebodies.

Character and Extent of the Ore Deposits. The productive ore is a chalcocite enrichment of pyrite monzonite porphyry, bringing the original 0.5% copper in the chalcopyrite as high as from 1 to 3%. The orebodies are



LONGITUDINAL AND CROSS SECTIONS OF COPPER FLAT-LIBERTY MINE, SHOWING ORE BODY AND EXCAVATIONS.
For position of sections see Plate XI. Data mainly from annual report of Nevada Consolidated Copper Co. for 1913.

irregular layers that lie beneath highly oxidized products of weathering and rest on entirely unweathered material, similar to the ore but without chalcocite. They occur medially along an east-west monzonite intrusion seven miles long, and one-half to one mile wide. The ore is a uniform light gray rock, from innumerable black specks of chalcocite, or of chalcopyrite and pyrite coated with chalcocite, but mainly the former, and its coverings are very much heavier. The white portion is quartz, orthoclase, and sericite; fresh yellow pyrite also occurs. Most of the pyrite that is coated with chalcocite is less than half a millimetre in diameter, while that not coated is mainly large and in bunches and seams. The only non-metallic mineral developed during the enrichment is kaolinite from orthoclase, and this is rare. An unusual appearance is black reticulating films of pyrite crushed by movement into dust, and coated with chalcocite.

In 1913, 80,000,000 tons of copper ore, with a small gold and silver content, including ore already mined, had been proved in this area. The 10th Annual Report of the Nevada Consolidated Copper Co. states that by December 31, 1916, they had developed in their own ground, 89,766,723 tons containing 1.6% copper, of which 21,773,606 tons, containing 1.67% copper, had been milled. To the first figure should be added 800,000 tons, on account of the Veteran mine. The latest tonnage developments are below the zone of distinct secondary enrichment, and, as a result of investigation, are thought to be primary.

Space prevents a description of minor ore occurrences in the jasperoid and shale, and in off-shoots from the main body in the porphyry. It is intimated that there is a definite east to west line of fracturing of the monzonite, which allowed the ascension of mineral-bearing solutions from depth, greater in volume than those contained in the intrusion itself.

Reviewer's Remarks. It is hardly probable that the Nevada Consolidated ground covers more than half the possibilities of the district. The geologic and topographic surveys were finished in 1910, and the report issued in November 1917. Is there room here for criticism? The Chainman vein was a continuous channel in the limestone, as developed say 1000 ft. long, 20 ft. wide, and sometimes 200 ft. deep, and uniform in appearance. It was a mass of rounded boulders and interstitial filling of silica, probably other non-metallics, magnetite, some lead carbonate, all deep red from abundant limonite. The persistence of the rounded boulders, from the size of a marble to 6 ft. diam., passing through the Chainman into the Joanna ground attracted everybody's interest; it was suggested that the creek once followed the lead, it being perfectly understood that the erosion was chemical and not by attrition. The best ore in large quantity averaged $4.50 gold, but small areas were richer. Above the lime there were also areas of shale metasomatically replaced by quartz; the bulk stoped probably averaged higher than $10. At the time of my examination in 1894 there was a remnant left in the bottom of an old stope. The metasomatism was interesting in its delicate completeness; the shale, almost entirely silicified, looked unchanged except for a glisten. The ore left was about 50 ft. long, 8 ft. wide in the centre, 3 ft. at each end, and it assayed $40 in gold, but it continued only about 10 ft. deeper, terminating without faulting in a conchoidal fashion against the big low-grade vein. The best ore was thus silicified shale, presumably Chainman shale. Possibly similar bodies yet may be found below the Joanna limestone in the Pilot shale. From here I was called to Monkey Wrench (afterward named Delamar, Nevada), and there I saw another phase of metasomatic replacement of quartzite by silica. One thousand tons had been shipped from the Discovery stope to Salt Lake, yielding $100,000. While sorting to this grade the owners had collected a few pounds of the best specimens. There was nothing to show its richness except spots in the quartzite made by the new silica, looking as if it had been wet with water.

It is always interesting to find important work like this referring geologically to the solid foundations of the 40th Parallel-Survey carried across the West by James D. and Arnold Hague, and S. F. Emmons, with Clarence King as their chief, whose charm of character seems depicted in the massive yet graceful tomes and atlas of the report. I asked Mr. Emmons how they managed to do it, just out of college, when there was not too much known of geology by anybody. He said, "We learned as we went; we taught ourselves by studying the structures."

Possibly some who may read this paper may not be familiar with Salt Lake and the history of the former Lake Bonneville. Should they ride from Ogden to Salt Lake City, they will easily note terraces along the hillsides denoting levels of the ancient lake 400 and 800 ft. above the present one. Before the Bonneville monograph was published I went with others over some of the remains of the old lake from Bear River, Idaho, southward, with G. K. Gilbert. He took us up the steep hillsides 400 ft. above Salt Lake, to show scarps in the terrace-gravels marking displacements by recent faults, assuring us that the upper bench which looked so near was really 400 ft. higher, as we could easily verify by following him there, but all were willing to take his word. Going over the immense bars formed by the old lake, and replying to flattering comments on his perspicuity, Mr. Gilbert laughingly protested, "Just a longshoreman; you don't need to be much of a geologist."

Monzonite is defined in the report, with reference to the feldspars, as a rock with equal amounts of orthoclase and plagioclase. Thus simplified it might be distinguished from granite, gabbro, and other rocks in the field; in fact granite is becoming scarce. Orthoclase is sometimes pinkish, but more often is only opaque as compared with plagioclase, and, on the latter, fine lines of multiple twining may usually be detected.

An interferometer is an instrument that makes use of the optical properties of gases, and is suitable for analyzing a binary gas mixture.

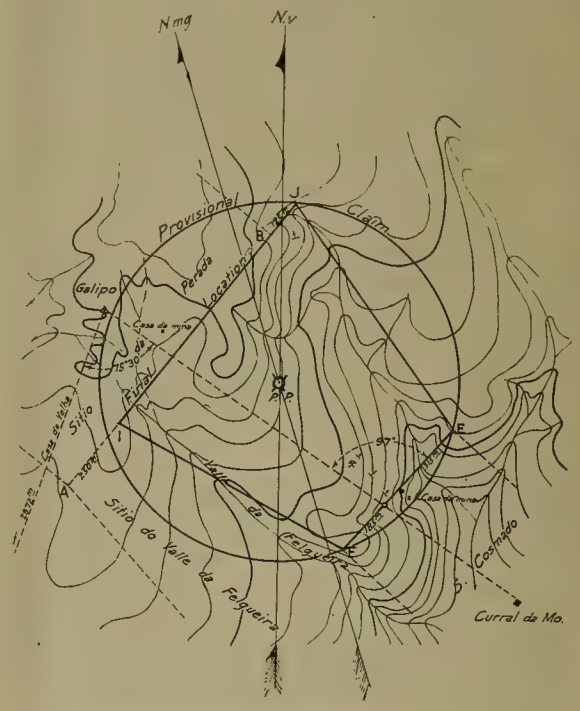
New Mining Law of Portugal

By GEORGE WARREN TOWER, Jr.

The mining laws of Portugal are of interest at this time because of the general discussion that has been going on for several years looking toward important changes in the mining law in the United States. It might be said, after reading the laws of Portugal, that the American law is so much more liberal that we should be content with our own. On the other hand, with reference to certain deposits, such as coal, phosphate, and oil lands, the authorities of the United States are coming to recognize the necessity of a leasing system.

As the Portugese law is essentially that of a leasing system for all mineral land, an abstract of the statute enacted in April 1917 will be interesting. The first article in the first chapter states that the mineral belongs to the Government and that the Government alone can concede the right to mine. This applies to all lands in the country, regardless of condition. One may have owned land with unconditional title since the days of Adam, but the mineral in that land, whenever or wherever found, belongs to the Government, and the right to mine it may be granted to any applicant at any time. Once a license has been granted the owner of the license has the right to condemn such portion of the land as may be necessary for conducting the operations of mining. The Government undertakes to distinguish between mineral and agricultural land, and to subdivide the mineral lands in accordance with the character of the deposit. Any person, Portuguese or not, may make a 'registo', or claim for a mining property. This is done by filing a document with the Municipal Chamber, which document is duly recorded in books kept for this purpose. The preliminary registration embraces a circular area having a radius of 560 metres in the case of metalliferous veins or placer deposits; 707 metres for graphite, coal, asbestos, salt, or gypsum; and 1600 metres for phosphates, nitrates, and hydro-carbons. The registration fee is $10. The centre of the circle covering the area within which the claim for a mine is to be determined or located, is referred to a government monument or some well-known natural object. No monuments or notices upon the ground are required. Within 60 days from the filing of the registration the locator must request of the Government a prospector's license, which takes from 30 to 60 days and $10 in cash to secure. Until this license has been granted it is illegal to prospect. The registrant gains no title to any land-surface, whether occupied or not, and when he begins to prospect he must arrange with the owners of the land, either privately or by condemnation proceedings, for the right to occupy such area as is necessary to properly prospect his claim. When the prospecting license has been granted, active prospecting must be begun within 30 days in conformity with a definite plan sanctioned by the Government, and within two years from the time of the original registration the registrant may apply for a mining concession. If the registrant prefers, he may apply for a mining concession immediately upon making his registration, and thus do away with the delay and expense of taking out a prospecting license.

The next stage is the procuring of a mining concession. This is preferably a rectangle, or it may be a polygon of 50 hectares, or 125 acres, within the registration circle, the commoner form of which will be seen by reference to the accompanying figure, which is a reproduction of survey of a well-known property in Portugal. In asking for a concession one is obliged to present maps and documents as follows: 1. A receipt showing that $120 has been deposited to the order of the Department of Mines in the Bank of Portugal; 2. a map on a scale of 1 to 1000,



EXAMPLE OF PROCESS OF CLAIM-LOCATION

giving contour-lines, and connecting the property, for which a concession is asked, with the government geodetic bench-marks; 3. a map on the same scale showing existing and proposed workings; 4. plans and sections on the same scale as the mine workings; 5. descriptions of the veins, proposed method of development, ventilation, system of draining, and methods to be used in mining, dimensions of shafts, drifts, and methods of driving same, methods to be used for tramming and transportation, both underground and on the surface, and any further data that may clarify the description; 6. plans of any metallurgical plant that may be contemplated; 7. representative samples of ore to be mined; 8. name of the manager who must sign all papers; 9. proof of financial ability to carry out the project.

The application is duly published in the government bulletin, and the statements are approved and verified by the engineers of the Department of Mines. After approval by the engineers the Government must grant the concession within 30 days.

Only after the granting of the concession can mining operations begin, and then only subject to the rules and regulations of the Government, as follows: 1. Work must be done according to engineering rules and all employers are subject to the police regulations of the district; 2. the operator must be responsible for any damage done to a third party; 3. he is responsible for any damage done by water from the mine; 4. he is responsible for any damage caused by allowing any workings to fill with water; 5. he must begin work on his concession within three months from the date when it was granted; 6. he must work the property continuously, except under rare circumstances; 7. he must keep the mine workings properly timbered and accessible; 8. he must not strip the mine workings so as to render future exploration of the veins difficult; 9. he must not stop work without due notice to the Government, and must leave the mine-workings in a safe condition; 10. he must pay the taxes imposed by law; 11. he must furnish maps and reports annually to the Minister of the Interior; 12. he cannot change technical managers without the permission of the Government; 13. he must provide sanitation for the workmen; 14. guard water for irrigation and not pollute streams; 15. extract only the mineral applied for in the concession; 16. employ no miners under 14 years of age underground; 17. furnish all possible information for mining statistics; 18. assist in making roads, railroads, and transportation systems; and 19. aid in welfare work for the miners.

In passing it should be noted that the law requires that the technical manager of a mining concession shall be a Portuguese. In practice this is merely a formality that provides employment for the engineers of the country. Also it should be observed that the concession once granted may not be transferred without the consent of the Government. If the owner of the concession is not willing to accept the conditions, he must make a declaration to this effect within 15 days, whereupon the Government advertises to see if there are others who desire the concession, and proceeds to sell same at auction. An interesting point of the law is that, while disputes are carried on in the usual courts of law, these courts cannot halt the operation of the property, but must find relief in the seizure of the product of the mine or mill.

The taxes are specifically fixed by the Federal law. The first fixed tax is upon the area of ground and averages about 18c. per acre per annum. The second is a proportional tax of 3% of the gross value of the ore when marketed. The third is a municipal tax not to exceed 10% of 7½% of the ore marketed. The fourth is a local tax which cannot be more than 2% of 7% of the gross value of the ore marketed. A special book of licenses or Government bills-of-lading is required for owners or concessions for removing mineral from a mining property and sending it to the local markets, and one governmental bill-of-lading must accompany each lot of ore whenever it leaves the property. This bill-of-lading must always be with that ore until it is finally consumed or sent out of the country. A special license is also required for exporting the mineral. Infractions of the laws are punishable by fines and by cancellation of the concessions. It is specifically stated in the law that forfeiture follows when work is not begun within three months from the date of granting the concession; if the owner of the concession does not properly guard the safety of the workmen; if the mining methods are bad so as to endanger the future of the mine; for failure to pay two fines; or for failure to pay taxes for two years; and when the mine is not in constant operation.

Portugal is essentially an agricultural country, and the mines are not extensive or numerous, as compared with the industry in the United States. They will become more important when the laws are amended so as to give greater protection to owners and less authority to government engineers. Wages are low, ranging from 10 cents to $1 per day. First-class miners get an average of 45c. per day. The development of the country to date indicates that the principal deposits are those of tungsten, copper, chromite, and antimony. Although iron, manganese, zinc, and lead have been found, they give little promise of great economic importance.

Definition of Ship Tonnages

We have been asked to explain the various terms applied to ship tonnages. Briefly they are as follows:

'Register' tonnage is so called because it is recorded in the Register of Merchant Vessels of the United States, and various fees are levied on this tonnage. It is the same as gross tonnage.

'Gross' and 'net' tonnage are based upon a unit of 100 cu. ft. of enclosed space; that is, 100 cu. ft. of enclosed space make on ton. The difference between 'gross' and 'net' tonnage is that 'gross' tonnage is a measure of the entire enclosed space, while 'net' tonnage is a measure of only such space as can be used for carrying cargo.

As the weights of different materials vary, 'gross' and 'net' tonnage are not constant. The 'gross' ton was officially made 100 cu. ft. of enclosed space in England in 1854. The United States adopted this measurement standard in 1864, and now it is universally used.

'Displacement' tonnage is the weight of the water which a ship displaces when floating at rest. The weight of the displaced water is exactly equal to the weight of the body. The naval architect, when designing a boat, must calculate the completed weight of the craft and must proportion and shape the underbody to make the weight of the water displaced at the desired water-line equal to the boat's weight. Every ounce of additional weight must be balanced by displacing an additional weight of water.

The 'dead-weight' capacity tonnage of a vessel is the load it is actually able to carry—or the difference between the weight of the ship with its engines, machinery, passengers, furnishings, and other specified items, and its 'displacement' weight. Fuel, water, crew, and passengers are not deducted in making this calculation. According to 'Motor Boat,' all submarine sinkings are given in gross tons. In the shipping industry a ton is always 2240 pounds.

REVIEW OF MINING

TORONTO, ONTARIO

Mineral Production of the Province for First Quarter of 1918

Returns received by the Ontario Bureau of Mines for the three months ended March 31, are tabulated below. For purposes of comparison the quantities and values are given for the corresponding period in 1917.

Product	Quantity 1917	Quantity 1918	Value 1917	Value 1918
Gold, ounces	127,692	113,387	$2,601,760	$2,265,521
Silver, ounces	3,945,957	4,114,856	2,831,873	3,740,843
Cobalt (metallic), pounds	84,710	37,545	78,668	75,625
Cobalt oxide, pounds	83,014	81,760	66,798	130,486
Nickel oxide, pounds	5,495	.....	550	.....
Nickel (metallic), pounds	.....	44,154	.....	17,662
Other cobalt and nickel compounds, pounds	118,292	143,381	13,695	18,386
*Nickel in matte, tons	10,141	9,677	5,070,410	5,806,200
*Copper in matte, tons	5,063	4,727	2,025,227	1,748,990
Copper ore, tons	1,507	.....	44,097	.....
Iron ore, tons	23,035	32,530	58,205	127,916
Pig iron, tons	163,020	148,752	2,743,441	3,948,209
Molybdenite, concentrates, lb.	25,073	17,410	32,202	24,548
Lead, pig, pounds	263,046	60,283	27,290	5,066

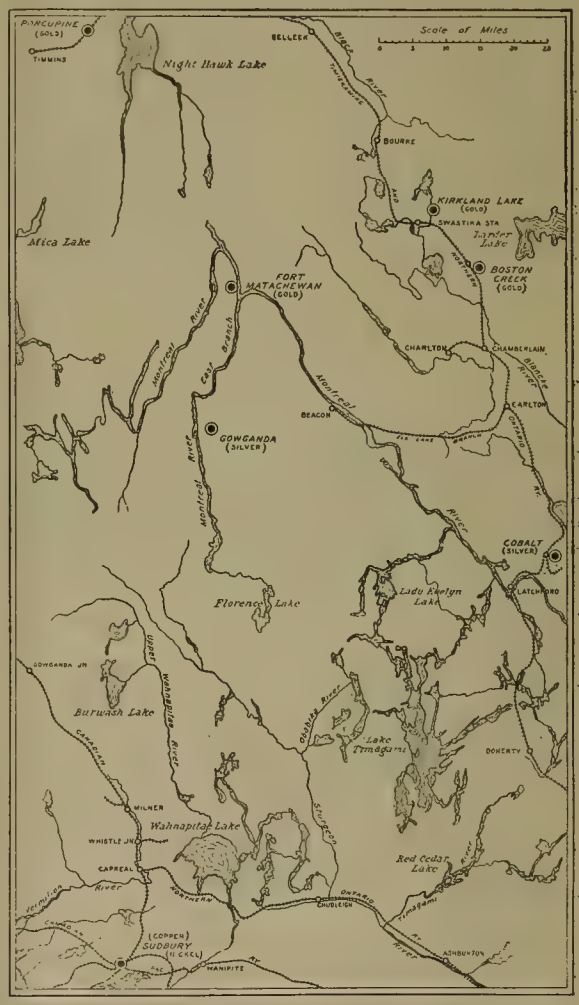
*Copper in matte was valued at 20c. and nickel at 25c. per pound in 1917. For 1918 the values have been placed at 18½ and 30c. per pound respectively.

Gold.—Production for the period shows only a small decrease, a creditable showing considering the various handicaps under which mines are laboring. The Hollinger had an increase in production which was offset, however, by the closing down of the Dome mill. The Croesus mine in Munro township has suspended work. At Kirkland Lake, a new producer, the Lake Shore, has been added to the list. During the quarter 262,577 tons of ore were treated, yielding 113,387 oz. of gold and 20,221 oz. of silver, compared with 350,916 tons milled during the corresponding period in 1917. Hollinger produced 68,804 oz. and McIntyre 21,461 oz., the next largest producer being the Porcupine V. N. T. The Patricia Syndicate at Boston Creek expected to have its new mill in operation about June 1.

Silver.—Shipments of silver for the first quarter of 1918 show a small increase in quantity and a considerable increase in value. The average New York price for the period was 87.5 cents per fine ounce, or nearly a 12c. increase when compared with this period of last year. Companies shipping 250,000 oz. or over are named in order: Nipissing, Kerr Lake, Mining Corporation of Canada, Buffalo, O'Brien, and Coniagas. The third has been re-modeling its mill in order to treat a large quantity of tailing from the Cobalt Reduction mill. At the McKinley-Darragh a new 200-ton oil flotation plant is in operation. Of a total of 4,114,856 oz. shipped, 20,221 oz. are credited to silver recovered from gold ores.

Refineries.—There were treated at southern Ontario refineries 1242 tons of ore and concentrates and 1483 tons of residue from Cobalt and outlying silver centres. Silver bullion recovered was 1,610,989 oz., worth $1,394,599. In addition, arsenic, cobalt and nickel oxides and sulphates, nickel carbonate, metallic nickel and cobalt were produced. Of the latter, 22,752 lb. was used in the manufacture of stellite, a cobalt alloy used as a high-speed cutting tool. One feature of note is the great increase, 100%, in value of cobalt metal and oxide due to the increasing uses and demand for these products.

Nickel-Copper.—Production from Copper Cliff and Coniston smelters for the quarter shows a small decrease. Ore was raised from the Creighton and Crean Hill mines of the Canadian Copper Co., the Alexo, and the following mines



MAP SHOWING MINING DISTRICTS OF NORTHERN ONTARIO

of the Mond Nickel Co.—Garson, Victoria No. 1, Worthington, Levack, and Bruce. Of a total of 354,689 tons extracted, about 70% came from the large and rich Creighton orebody. There was 325,386 tons of ore smelted in the period with a resulting product of 17,992 tons of nickel-copper matte.

The British America Nickel Corporation has acquired a site to erect its $1,000,000 refinery on the Quebec side of the

Ottawa river between Alymer and Hull. The new refinery of the International Nickel Co. of Canada at Port Colborne is nearing completion.

Iron Ore and Pig-Iron.—Shipments of iron ore were made from the Helen and Magpie mines of the Algoma Steel Corporation. Hematite ore from the Helen is shipped to the Magpie, where it is mixed with siderite ore and roasted. The entire shipments from the Magpie went to the Sault blast-furnaces. From Moose Mountain Limited, Sellwood, shipments were made of magnetic concentrates, briquetted and converted to hematite in a kiln. Only 447 long tons was exported to the United States during the quarter.

At Sault Ste. Marie, Port Colborne, Hamilton, and Deseronto, eight blast-furnaces were in operation. The quantity smelted was 34,552 tons of Ontario ore and 260,476 tons from the United States. As shown by the table, the output of pig-iron was considerably less than for the corresponding period last year.

Molybdenite.—Molybdenum ore, to the extent of 1295 tons, was treated by the Mines Branch, Ottawa, and by the Renfrew Molybdenum Mines, Ltd., at Mount St. Patrick. The output of the latter is shipped direct to France. There are works at both Orillia and Belleville for the production of ferro-molybdenum.

Lead.—The entire output of pig lead resulted from the operations of the Galetta lead mine and smelter owned by the James Robertson Estate, Montreal. During the quarter 3347 tons of ore was mined. The smelter operated during the last few days of March only. Operations by the Kingston Smelting Co. ceased in December of last year.

GILBERT, MINNESOTA

Operations in the Iron-Ore Districts.

Stripping at the Mace mine is being done by Butler Bros. and will soon be completed. The work consisted of moving the overburden from over some pillars of ore left during underground operations. A small Marion revolving shovel was used and one locomotive for the dump-cars.

The Republic Iron & Steel Co. started work on the large pile of ore accumulated during the winter from underground workings of the Bray mine. A steam-shovel was received some days ago from the Kinney mine, and was put to work. A large body of ore has been developed in the Gordon, and this as well as new ground will be thoroughly drilled. There are now seven drills on the Gordon and Bray properties.

Work has been started on the Sargent property (160 acres) of the Wisconsin Steel Co. west of Keewatin. This new mine is west of the Bray. A great deal of exploration has been done during the past three years and a large tonnage of ore has been exposed by diamond-drills. This mine will be worked by both open-pit and underground systems. The former will not be a large one. Underground work will be of the usual standard in this district. There will be the regular four-compartment shaft sunk to about 180 ft. There is little prospect of the Sargent mine shipping any ore this year, but it will be on the list next season. B. W. Batchelder is superintendent.

The war gardens at the Bray, Gordon, Sargent, Mace, and Bennett mines have been ploughed and harrowed, and are all ready for seeding as soon as the ground is warm enough. The soil is in much better shape than last year, and chances are much better for a large crop of vegetables. There is enough land at the different mines so that every family will have an opportunity to raise all of its winter supply.

Drilling for iron ore will be soon started in the northern part of Itasca county, northern Minnesota. Indications are good. Samples so far are of the Vermillion type, and assays have been unusually high in iron. It is expected that drilling will start early in June. Many prominent mine operators have already visited this new field.

PLATTEVILLE, WISCONSIN

Zinc-Ore Prices, Labor, Concentrate Reserves, Lead, Pyrite, and Production Conditions in May.

Operating conditions in the Wisconsin field at the beginning of May were unsatisfactory and unprofitable. The price offered for 60% zinc concentrate was under $50 per ton, with premium grades of refinery ore as high as $52 per ton. Low-grade producers were offered less than $20 per ton for 30% separator product, claimed to be under production cost. Second-grade ores were in better demand, with the range down to $45. This situation was as distressing in the Joplin district of Missouri, but operators there were more alert to their interests, and meetings held at Washington resulted in the appointment of an allocating committee, with privileges that enabled adjustment of prices ($75) on zinc concentrate entering into the manufacture of rolled or sheet-zinc. About mid-month the price on a certain quantity of high-grade refinery material was advanced to $65 per ton; the remainder of the month brought the top price paid to $70.25 for Wisconsin ore. Standard 60% product not entering into the manufacture of rolled zinc received a boost, the base going to $60, with the range on second grades down to $45. This range was in effect at the close of the month.

Labor conditions, acute early in the month, were further aggravated by the draft. The immediate result of this additional exodus of able-bodied men was reduced operations at nearly all of the large properties and the shutting-down of mines at nearly all points in the field until capacity was reduced to about 60% of normal.

Restricted deliveries of concentrate augmented a fair reserve in bin at the beginning of May, until near the close of the month there had accumulated the largest reserve ever known in the field, conservatively estimated at 7500 tons. Individual instances were acknowledged by officials showing over 3000 tons held by the Block-House Mining Co. of Platteville, 2000 tons by the Frontier Mining Co. of Benton, and 1500 tons in the Shullsburg district. This stock served to slow-up buyers, it being patent to smelter representatives that there was sufficient blende available for their demands for some time to come, and that the surplus would rather be increased than lessened.

Mine development was brought to a halt at all points in the field, and except where mills were well along toward completion, building and mine equipment was suspended. Drilling continued at a fair rate in the Mifflin, Benton, New Diggings, and Galena districts, and satisfactory discoveries of new orebodies were reported. Refineries were active most of the month.

Offerings for lead ore were well maintained through the month. The price opened at $80 for 80% metal content, advancing gradually under good demand to $85 per ton base, at which figure the month closed. Some ore was sold, but not much, producers being content to hold for better prices. With a lower output of zinc there came a reduced recovery of lead. Careful tabulation showed that there must have been in reserve at the end of the month 2000 tons of lead ore.

Shipments of pyrite showed a decided increase over previous months, following large demand for sulphuric-acid manufacture. The reserve was entirely eliminated. No crude ore was offered for sale, but the advance in price of pyrite to 27c. or better per unit of sulphur, and the prospect of a steady demand at fair prices, stimulated the work of exploration at several points. In the Montfort field, where large deposits of iron pyrite (marcasite) are known to exist, seven drill-squads were at work all the month in a small area, and extensive discoveries were announced. Local capital is behind the new undertaking, but it will require several months before deposits can be reached and mined successfully, so that the refineries will be depended

upon to supply such ore as will be made available from electro-static zinc-ore separation.

Shipments totaled 18,587 tons of zinc-blende, 472 tons of lead, and 483 tons of pyrite from mines to separating plants in the field, and from mines to smelters direct during May.

The gross recovery of raw concentrates from mines totaled 20,049 tons, and net deliveries out of the field 13,806 tons. The Mineral Point Zinc Co. received 7595; Grasselli Chemical Co., 4893; Wisconsin Zinc Co., 4414; National Separators, 2730; American Metal Co., 1304; Linden Zinc Co., 1190; Illinois Zinc Co., 632; M. & H. Zinc Co., 572; American Steel & Wire Co., 532; Lanyon Zinc Co., 188; and Benton Roasters, 118 tons.

NEW YORK

Transactions in Liberty Bonds.—Financial Situation.

The continued drop in value of the last two issues of Liberty Bonds in the open market is a matter for further discussion. Conjectures for the reason of the downward tendency are numerous. The recent low prices of 93.52 and 96.36 for the 4s and 4¼s, respectively, indicate abnormal selling. The reason should be sought to prevent lack of confidence in future issues, if for no other cause. It has been suggested that liquidation has been due, in large measure, to the transfer of money from Liberty Bonds to farm-loan issues, which carry a higher rate of interest; but it is unlikely that there is any extensive movement in this direction. Another phase of the matter seems to have escaped attention. The efforts made by the Committee to reach and influence the greatest number of wage and salary earners were unparalleled, and resulted in complete success. The immense increase in the number of subscribers, particularly in the matter of the smaller bond denominations, indicate this success on a per capita basis. The educational campaign to teach the duty to purchase, to inculcate the idea of privilege in assisting the Government, and to emphasize the soundness of the securities behind the bonds, was carried out with a vigor that reached all quarters and resulted in a response from all sections of the community. As a sales effort the campaign exceeded all expectations; but with the last sale all interest in the subscribers, as subscribers, seemed to cease. Information as to the current market-value of the bonds is disseminated in all newspapers, and millions of uneducated people are wondering why the bond they bought only a few weeks ago for $100 is now selling for only about $96. The necessity of allowing Liberty Bonds to mature, and the lack of patriotism shown by those who part with them, except under necessity, are matters yet to be emphasized to the people. The result is that an indeterminable number of bond holders are the victims of crooks and sharpers who prey on those whose education, in what was to them a new world of finance, ceased as soon as they had paid the money. The modus operandi of these gentry is as follows: No difficulty is experienced in finding out who holds bonds, as subscribers were asked by the Committee to advertise the fact by wearing a button. The next step is to get into touch with the victim and, in glowing terms, indicate the advantages of coming in 'on the ground floor' and purchasing a block of stock in a new company with amazing undeveloped resources (now paying a paltry 12 or 15% interest) at $1 or so a share. The interest rate is, figuratively speaking, a fleabite; but invites mental comparison with the 4¼% paid to Liberty Bond holders. The next step is to promise the victim that the shares can be sold in about three months time, when the stock will be placed on the market, at double the price now offered, thus insuring a 200% return of the money, plus the dividends received in the meantime. Then follows a specious and carefully-prepared argument in which the victim is eulogized for his patriotism in buying Liberty Bonds, and told that, now that the Government has the money required, it is immaterial what he does with the bonds. He is reminded that the interest received on his money is only 4¼% and that the market-value of the bonds is decreasing daily. As a further incentive to get him to part with his bonds in exchange for a block of worthless shares he is told that full par value will be allowed in any such transfer. How many holders can be hoodwinked by such a yarn is a matter for speculation, but the fact remains that the scheme is in full operation. By what devious routes such bonds travel before they reach the open market, and in what quantities they are disposed of, would prove interesting reading. For the benefit of those who realize, without being told, that both duty and patriotism involves the holding as well as the buying of war bonds it is hoped that steps will be taken to prevent liquidation from such a cause as the one mentioned. The protection of the uneducated or gullible holders of Liberty Bonds against the machinations of bogus oil-well or other sharks should be a post-campaign feature of the next issue.

Price movements during the past week afford further proof that depressing news has little or no effect, whereas good news results in an all-round appreciation. The total volume of sales still shows a considerable decline from previous years, and this is largely due to national-bond holding. Saturday's (June 8) sales in stocks were less than half the number disposed of on the same date last year; whereas bond sales amounted to over 3½ times the number. The increased activity in bonds is directly traceable to Liberty Loan movements. Buyers are now to the fore, and the 4s of the second Loan moved recently from a low of 93 to a closing quotation on Saturday of 95. The 4¼s of the third Loan also advanced.

OTTAWA, CANADA

Iron, Steel, and Coke Situation.

The problem of securing sufficient steel for munitions and for much-needed construction is engaging the close attention of the Canadian government. Last week a number of representatives of the principal steel manufacturers conferred at Ottawa with the Government and the Imperial Munitions Board. The commandeering of the entire steel output for war purposes was considered, but the objection was put forward that it would dislocate many departments of the plants and severely injure export trade, and, in the meantime at any rate, less drastic measures have been adopted. In order to encourage the establishment of new iron and steel industries, the Government has decided to purchase all pig-iron produced in Canada by any new blast-furnaces erected during the next two years. It will agree to take all of the output for three years at a price to be governed by market-conditions at the time. Some of the manufacturers urged the granting of a subsidy, but after full consideration it was decided that this would be unwise at present. The Dominion Steel Corporation has done much preparatory work in connection with the construction at Sydney, Nova Scotia, of a ship-plate rolling mill in accordance with its agreement with the Government. It will have a capacity of 100,000 tons per annum, of which the Government will take from 50,000 to 75,000 tons yearly for a 5-year period. The corporation is also erecting a new coke-oven plant, comprising 120 by-product ovens of the Koppers type, 11.3 tons each, with a total guaranteed output of 1320 tons daily on 16-hour coking time. The first battery of 60 ovens will be in operation this month, May, and the second unit a month later. The present plant, consisting of 620 Otto Hoffman by-product 4 and 6¾-ton ovens, is badly out of repair, giving an output of only 1600 tons per day. As soon as the new ovens are in operation the others will be repaired. The present coal-washer will be replaced by a new Simon-Carves plant, which will give better results.

THE MINING SUMMARY

ALASKA

Juneau.—Alaska Gold in May treated 101,200 tons of $1.11 ore. Extraction was 81.24%. Tonnages since January are, 179,300, 140,305, 150,093, 125,435, and 101,200, respectively.

The Alaska Juneau company's 8000-ton mill is shut-down. As it is not economical to operate it on a 1000-ton basis the old 40-stamp pilot-mill is handling all the ore available at present. There are 175 men employed, but P. R. Bradley states that 350 are needed.

Ruby.—In Bulletin 667 (54 pages) of the U. S. Geological Survey, the Cosna-Nowitna region is described by Henry M. Eakin. This area has produced no mineral wealth. Auriferous gravels have been found at a few places, but no placers justifying exploitation have been discovered. The placers are most likely to be found on streams where the overburden is probably very deep, therefore the field is not attractive to



MAP SHOWING SITUATION OF COSNA-NOWITNA REGION

prospectors. Some of the geologic formations are similar to those that are gold-bearing in districts on the north-east and north-west. Search for gold in streams that cross the granite contacts is most likely to be successful. The region as a whole is fairly accessible, many of the streams being navigable for small boats. It is well timbered, and includes much fertile land similar to that near Fairbanks.

ARIZONA

Ajo.—Considerable water is being encountered at a depth of 140 ft. in churn-drilling at the Little Ajo property.

Bisbee.—The Copper Queen Branch of Phelps-Dodge Corporation announces that commencing July 1 all employees will be given a yearly bonus of $100 at the end of one year's continuous service, to be increased for each succeeding year. The Calumet & Arizona and the Shattuck Copper companies announce a similar plan. Phelps-Dodge paid $6 per share on June 20.

Globe.—Old Dominion produced 3,239,000 lb. of copper in May, against 2,814,000 lb. in April. On June 28 the company pays $1 per share, making $2 for the current year.

Jerome.—On May 21, Judge Lyman of Maricopa county, in the Superior Court of Yavapai county at Prescott in special session, granted the petition of the minority stockholders of the Hull Copper Co. and appointed R. H. Hetherington receiver of the company and of the block of shares held by Charles W. Clark, trustee. The appointment was made over the objections of the attorneys for the Hull Estate and Clark, who gave notice that the matter would be appealed to the Supreme Court and signified their intention of furnishing the supercedeas bond in the sum of $1,000,000 in order to stay the process of transferring the Clark and company's holdings to the receiver. On May 31 attorneys representing the Clark interests filed the supercedeas bond of $1,000,000 required by the Court, thus having the effect of staying the proceedings of turning over the property of the company to the receiver. The bond was signed by W. A. and Charles W. Clark as principals with the following sureties: E. W. Wells, M. B. Hazeltine, Mrs. Hugo Richards, J. I. Gardner, Jerry W. Sullivan, Henry Brinkenmeyer, C. A. Peter, and O. A. Hesla, all of Prescott, and Walter C. Miller of Jerome.

Superior.—Magma Copper pays a dividend of 50c. per share on June 29.

COLORADO

Breckenridge.—All the dredges in this district are working full time. Tonopah Placers has three, the French Gulch one, and the Powder River company of Oregon one boat.

Crisman.—At the Yellow Pine claims 18 sets of lessees are extracting a large tonnage of silver ore. Numbers of old silver mines in this district are being re-opened.

Denver.—Mine operators of this State will protest against the increase in freight-rates. They consider that production of gold, silver, lead, zinc, and copper will drop at least 50%. The smelters have already increased their charges on bullion shipped from them. Cripple Creek will be considerably affected. According to the State Commissioner of Mines, Fred Carroll, there is 10,000 tons of bullion shipped out of Colorado every month. The freight increase is about $6.50 per ton, or a total for the month's business of $65,000. Adding to that amount the accumulation of increased costs due to the general order, the increase for an entire year will be well in excess of $2,000,000. Comparing these figures with the aggregate net earnings of $3,200,000 for 1917, or rather deducting that amount, will readily show that the producers find it almost an impossibility to continue operations, even for needed war minerals and metals. Dividends paid in Colorado during 1917 were the leanest for 10 years. A few bonanza properties like the Cresson at Cripple Creek, the Wellington at Breckenridge, and the Tomboy at Telluride were exceptions to the rule.

IDAHO

Kellogg.—The Coeur d'Alene Antimony company is remodeling its mill, putting in a flotation plant, using the K. & K. apparatus. In bins is 2000 tons of ore. A good deal of ore is said to be blocked out in the mine, which is on Pine creek.

Moscow.—An extensive geological survey, requiring the entire summer, is under way by the Idaho School of Mines, with L. C. Livingston in charge. Search is being made for

tungsten, molybdenum, mercury, tin, platinum, and mica. All promising prospects are being examined and samples of ore thought to contain any of these minerals will be analyzed.

Mullan.—The National copper mine has been closed indefinitely, with no plans for the future. During May the 500-ton mill dressed ore averaging 1½% copper and 4 oz. silver per ton. According to the manager, Charles McKinnis, ore on the 1500-ft. level is more oxidized and leached than in the upper levels. The Snowstorm fault, which cuts the National vein, is considered responsible for this condition.

Wallace.—Statements filed with the County (Shoshone) Assessor show the following results for 1917 from Coeur d'Alene mines, compared with 1916 and 1915:

Company	Ore mined or shipped, tons			Gross Value			Profit		
	1917	1916	1915	1917	1916	1915	1917	1916	1915
Anaconda (Douglas)	7,799	.....	.....	$ 346,718	.....	.....	$ 23,477	.....	.....
Black Hawk	15,600	89,000	.....	117,126	39,385	.....	3,873	2,852	.....
Bunker Hill & Sullivan	493,030	475,784	454,205	9,584,963	6,253,048	4,177,819	2,447,286	1,310,971	1,145,855
Caledonia	38,557	46,177	42,628	1,849,255	1,769,670	1,246,860	1,227,155	1,154,763	761,797
Con. Interstate-Callahan	161,455	146,317	113,795	3,250,835	3,983,522	4,540,672	1,234,064	2,481,537	2,921,488
Federal	678,763	654,844	439,398	6,018,074	5,067,954	2,901,083	1,617,146	1,265,379	658,222
Gold Hunter	116,562	119,490	118,764	994,408	815,779	614,590	130,813	161,361	32,663
Green Hill-Cleveland	18,012	29,465	28,126	1,341,331	1,851,743	1,643,799	137,323	401,826	497,864
Hecla	374,213	250,559	146,675	4,462,031	3,281,136	1,422,579	1,895,065	1,681,059	593,680
Hercules	108,052	87,179	49,441	9,880,979	7,278,258	3,090,175	3,690,401	2,931,136	1,096,019
National	13,374	.....	.....	72,742	.....	.....	.....	.....	.....
Ontario	1,201	36,685	81,208	32,811	392,078	689,393	7,637	162,182	223,725
Sierra Nevada	.....	17,839	15,159	2,120	4,180	110,328	.....	5,794*	46,354
Success	57,297	63,062	21,867	350,105	702,902	1,255,802	102,091*	222,328	898,936
Stewart	.....	47,594	180,017	.....	334,674	1,557,628	.....	40,156	572,232
Tamarack & Custer	16,916	15,964	26,147	1,338,322	1,013,779	1,238,755	350,859	338,746	346,796
Wyoming	127	1,565	.....	854	12,680	.....	15	1,323	.....
Total				$39,677,698	$32,800,798	$24,489,481	$12,765,113	$12,154,620	$9,794,632

*Loss.

MISSOURI

Joplin.—Concentrate production of the region last week was 6440 tons of blende, 107 tons of calamine, and 1168 tons of lead. These averaged $47, $33, and $87 per ton, respectively. The total value was $432,152, of which Missouri contributed $214,477. Total for 23 weeks is $10,741,558.

The Essential Producing Co. of Miami and Kansas City is the name of a new company which proposes to drill leases, operate mills, and a smelter, etc. A 150-ton mill has been secured in the Lawton-Waco district, and is recovering 6% blende and lead. Between Hockerville and St. Louis the company has cut rich ore by drilling, and is to sink a shaft. Also, the company has 600 acres of oil leases in the Chelsea-Nowata field. Well-known Missourians and Oklahomans are interested, with C. R. Hemmenway as general manager.

NEVADA

Carson.—The Industrial Insurance Commission has announced changes in compensation and accident benefit rates for the State, effective July 1. During 1917 the mining companies contributing to the fund paid a compensation rate of $3.50. During January, February, and March of the current year this rate was reduced to $3.25. The rate in April, May, and June was fixed at $3, and during July it will be $2.75, the rate being based on each $100 of payroll. The milling rate up to June 20, 1918, will be $2, and beginning July 1 it will be $2.25. During April there were no fatalities, while in previous months the average was six.

Graphite is reported as having been found just beyond the hot springs north of the city by C. R. Dake. The Black Hope and O. K. graphite mining companies have been organized.

Goldfield.—The Goldfield Great Bend Mining Co. has issued a report covering the period of February 1, 1916, to April 1, 1918. During this time 2388 tons of ore was sold averaging $38.62 per ton. Mining, freight, smelting, etc., total $61,215. This deducted from the gross value, $92,203, left a profit of $30,988. Development—4633 ft.—cost $54,578. In May 1916, pumping was started, and the shaft was unwatered to 420 ft. From the 250-ft. point the shaft was full of debris, and had to be re-timbered to the 500-ft. levels. Difficulties at 400 ft. made necessary a change to the 236-ft. level, where a good deal of work was done. In January 1918 this level reached the 418-ft. Lockhart shaft, and it is intended to thoroughly prospect the ground adjacent. On the 160 and 236-ft. levels there is enough ore showing to keep a 25-ton mill at work, so tests are to be made as to the best method of treatment. Although the period resulted in a loss of $25,529, the company's assets total $23,248, of which $1585 is cash.

Goodsprings.—The Yellow Pine company has arranged a contract with the Empire Zinc Co. for 1200 tons of mixed ore per month.

Mill City.—There are 150 men employed in this new tungsten district. The Pacific Tungsten Co. is sinking four shafts. Regular shipments are sent to the mill at Toulon.

Tonopah.—The present situation at Gold Mountain is said to be very promising. The Tonopah Divide is sinking to No. 3 level. The Brougher Divide is cross-cutting from the 170-ft. level. Divide Extension is making good progress at 150 ft. The Dividend will sink to 250 ft. before opening out. The Hasbrouck has driven its tunnel over 40 ft. in foot-wall formation, assaying from $2 to $4 per ton.

OKLAHOMA

Picher.—Oklahoma districts last week produced 4742 tons of blende and 935 tons of lead, valued at $217,675.

The Eagle-Picher company is trying mules in its mines.

OREGON

Gold Hill.—The Rainier Mercury Co. has found a large vein of good cinnabar in the Meadows district, 12 miles north of Gold Hill. They have a 12-pipe furnace at work, and shipped 40 flasks last week.

Jacksonville.—The Blue Ledge copper mine is employing 65 men, shipping 150 tons of ore per week. This assays 12%. The haulage-charge is $10 per ton.

Waldo.—The California Chrome Co. has purchased from George S. Barton and associates of Grants Pass 24 chrome claims on Smith river near the Josephine County-California State line. Much development has been done, and a large tonnage is available for shipment by way of Crescent City, California.

UTAH

Bingham.—On July 1 Bingham Mines pays 50c. per share. This amounts to $71,500, making $393,250 to date.

Shareholders in Montana-Bingham are said to be dissatisfied with the present state of affairs and are to demand a change.

Parke City.—Production of this district in May was 10,165 tons of ore worth $500,000. The Ontario headed

the list with 3440 tons. This company pays 50c. per share on July 5. This is equal to $75,000, and makes $15,037,000 to date.

On June 22 Tintic Standard company paid 6c. per share. This equals $70,480, and makes $188,980 to date.

Tintic.—More manganese is to be extracted by lessees in the Chief Consolidated mine at Homansville. The present daily output is 10 to 15 tons of 45% ore.

The Utah Zinc Co. at West Tintic is producing rich lead-zinc ore, also some manganese.

The Iron King shaft in Eureka district is down 450 ft. below the tunnel-level, equal to 800 ft. from surface, in promising formation.

The Tintic Milling Co. is treating 200 tons of ore daily, somewhat below capacity. A recent bullion shipment amounted to 66,000 lb., valued at $50,000.

WASHINGTON

Chewelah.—United Copper recently shipped 42 tons of ore which assayed 16% copper and 102 oz. silver per ton. This was obtained by sorting on the 1250-ft. level. May shipments were 2 cars of crude ore and 14 of concentrate.

Olympia.—'Manufacturing Opportunities in the State of Washington' is the title of a 240-page bulletin issued by the Bureau of Statistics and Immigration. The mineral resources—non-metals—are covered by Henry Landes, State Geologist, and metals by Milnor Roberts, dean of the College of Mines at Olympia. Coal is the most important non-metal produced. The industry employs 5000 men, and accounts for half of the State's mineral output. Clay and cement are also important. The precious-metal yield is not large, but capable of expansion. Copper is widely distributed, largely in regions difficult of access. Lead and zinc show good increases of late. The U. S. Bureau of Mines has an experiment station at Seattle, where much investigation is under way.

Valley.—The International Portland Cement Co., operating at Irvin, east of Spokane, is calcining magnesite from mines near Valley. The kilns are dealing with 1000 to 1500 tons per week, producing half of this quantity of calcined material, the rate of reduction being about two into one. C. A. Irvin is manager.

CANADA

British Columbia

Ainsworth.—The Florence Silver M. Co. is now working profitably. Net earnings in April were $17,960. Concentrate assays 20 to 26 oz. of silver and 70 to 80% lead. On July 1 an electric locomotive will start hauling 12 ore-cars on No. 3 tunnel-level.

Ladysmith.—The custom smelter here is to be blown-in about June 20, according to W. J. Rattle, general manager for the Ladysmith Smelter Co., who returned to Seattle recently from New York, where satisfactory financial arrangements were made for the resumption of operations. This plant was active for a while last year, but was closed to permit of re-organization and to provide for a continuous supply of ore. Both of these objects have been accomplished. The company will operate under lease and bond what is known as the Willow Grouse claims in the East Sooke district, Vancouver Island, from which several satisfactory shipments have been made. There are 2000 tons of coke on hand at the smelter as well as 2000 tons of basic copper ore, which has been held over pending the securing of silicious ore for fluxing. The Hon. William Sloan, Minister of Mines, has taken a keen interest in the effort to develop conditions that would warrant the smelter's re-opening, not temporarily but with reasonable assurance of being able to continue, and he is satisfied that the small mine operators of the Island and of the Coast sections of the mainland of the Province will find the smelting facilities thus provided a real boon. The resident engineers for the Coast mineral survey districts—George Clothier and W. M. Brewer—report that there should be several mines developed during the coming season to a sufficient extent to



assure regular shipments of such size as to keep the plant working to capacity.

Trail.—From January 1 to May 21 the Consolidated M. & S. smelter here reduced 165,832 tons of ore. Le Roi of Rossland contributed 41,101 tons. Sullivan, 36,575; Center Star, 34,164; Emma, 15,062; and mines in Washington, 3228 tons.

The Consolidated M. & S. Co. pays 2½%, equal to $261,936, on July 2. This makes $4,501,723 to date.

Victoria.—There is an area on Vancouver Island, approximately 3296 square miles (the whole of the island comprising only 17,000 square miles), which is termed the Esquimalt & Nanaimo Railway Belt, there are applied both company and Provincial regulations for mining operations. This dual control has so complicated titles to claims within the section that development within its limits has been seriously hampered. With a view to curing this undesirable position the Minister of Mines at the last session of the British Columbia Legislature asked for and obtained authority to enter into negotiations with the company looking to the establishment of a single authority in regard to the minerals of the E. & N. Belt, that authority to lie in the hands of the Province. It may be said, by way of explanation, that these lands were given the original builders of the railroad as a bonus for their enterprise.

The Strathcona Park Amendment Act is a measure passed by the 1918 Legislature of British Columbia which is of special interest to prospectors of the North-West. This opens to exploration a highly-mineralized area of Vancouver Island comprising 530,066 acres. It was closed some years ago in order that it might be preserved in its natural state as a National park. It is claimed by the present Government that development of its mineral cannot interfere, at any rate to any material extent, with its value as a park, consequently permission is now given to miners to record claims within its limits, and to proceed with mining in the usual way.

Ontario

Cobalt.—The Ophir Cobalt Mines Co. is doing interesting work and a recent circular is optimistic as to the future. A winze is being sunk below the 440-ft. level, near where a shoot of 1600-oz. silver ore was opened.

MEXICO

Durango

Batopilas.—Another rich silver shoot is reported as having been opened in the Batopilas mine.

Sonora

Cananea.—Greene Cananea Copper Co. has issued its report for 1917, including its subsidiaries, the Cananea Consolidated Copper Co. and the San Pedro Copper Company.

The properties were operated from January 1 to June 22, after which they were closed on account of Federal and State government action. A better understanding was reached with the authorities, and work was resumed on December 10. At present all plants are in operation. Sales of metals, etc., realized $9,392,639. Expenses, including $643,751 for administration and American taxes, and $842,766 for Mexican bullion taxes, amounted to $6,623,137. After charging depreciation with $350,455, and adding $78,842 for interest, the net income was $2,497,888. The surplus at end of 1916 was $9,504,979, and at end of 1917, $8,048,652. Four dividends absorbed $3,954,215. Current assets total $8,405,579, and liabilities $892,384.

Development at the mines of Cananea Consolidated amounted to 26,027 ft., and at the San Pedro 4824 ft. More ore was exposed than extracted. The most important development, though not the largest, was near the Campana shaft of the Sierra de Cobre mine, in a hitherto unproductive zone of large extent.

The concentrator dressed 171,202 tons of ore, 70% by flotation. The smelter reduced 481,632 tons of copper-bearing material. Results may be tabulated as under:

	Cananea Consolidated	San Pedro
Ore mined, tons	574,582	56,924
Copper output, pounds	24,711,204	2,658,014
Silver, ounces	655,656	122,137
Gold, ounces	3,804	723
Recovery per ton:		
Copper, per cent	2.273	2.526
Silver, ounces	1.153	2.486
Gold, ounces	0.006	0.013
Cost of copper, cents per pound	17.951	12.692

The last item includes the shut-down expenses and taxes on production. There were 185 Americans and 3794 Mexicans employed.

All the properties and works are now owned by the Cananea Consolidated Copper Co. as of January and July 1917.

The Committee on Mineral Imports and Exports in Washington has finished the work for which it was formed, namely, that of formulating programs for the minimum importation of ores and minerals, in order to save shipping for war purposes, without crippling any essential industry. These programs have now all been formulated and approved of by the various Government departments interested and are practically all in effect. Therefore the Committee has thought best to terminate its existence as such. Routine work connected with questions arising from the enforcing of the programs will be handled by the former staff of the Committee under the direction of Dr. E. F. Gay of the United States Shipping Board, under whose authority the Committee was organized for the purpose above mentioned. The Committee consisted of Messrs. C. K. Leith, J. E. Spurr, and Pope Yeatman, representing the Shipping, War Trade, and War Industries boards. Messrs. Leith and Spurr remain in a consulting capacity to the Shipping Board as Mineral Advisors. In addition to this, Mr. Leith has been appointed Mineral Advisor to the War Industries Board fro mthe standpoint of the conservation of shipping; and Mr. Spurr has accepted an invitation to take charge of the War Minerals Investigation Campaign for the Bureau of Mines. Mr. Yeatman continues in charge of the Nonferrous Metals Division of the War Industries Board.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Charles M. Becker is at Santa Fe, New Mexico.

F. L. S. Holland passed through San Francisco on his way from Arizona to Denver.

Albert Roberts, of the Minerals Separation company, returned here from Joplin and has gone to Seattle.

C. O. Lindberg of Los Angeles is at Washington on business in connection with the U. S. Bureau of Mines.

H. C. Buckminster, general manager for the New Idria Quicksilver Mining Co., California, is here from Boston.

Frank Daniels passed through San Francisco on his way to Pasadena, after investigating nitrate deposits in Mineral county, Nevada.

F. W. Bradley, Jules Labarthe, and **Roy Bishop** visited the Northwest Magnesite Co.'s mine near Chewelah, north of Spokane on June 11.

A. P. Bradley, metallurgist at the Murray plant of the A. S. & R. Co., near Salt Lake City, was married in San Francisco on June 6.

Fred. Searls Jr. has been promoted from the ranks to First Lieutenant, and is now instructor in a school of military engineering in France.

J. O. Elton succeeds **Milo W. Krejci** as assistant superintendent of the Boston & Montana plant of the Anaconda Copper Mining Co., at Butte.

B. S. Morrow has been appointed superintendent of concentration at the Washoe reduction works, at Anaconda, his place being taken by **S. S. Rodgers.**

Hallet R. Robbins has resigned his position as consulting metallurgist with the Granby Consolidated company to accept a commission in the Army. He is now at Washington.

G. Montague Butler has just been appointed Director of the Arizona State Bureau of Mines to fill the vacancy created by the resignation of **C. F. Willis.** He will continue to serve as dean of the College of Mines and Engineering, the position he has held for three years.

John W. Cotton has been wounded—only slightly, fortunately—in France, according to the casualty list of May 12. He is the son of John W. Cotton, of Railroad Flat, California, and enlisted in 1914 when only 19 years of age, serving in the Mexican campaign before going across with General Pershing's troops to Europe. He obtained his commission in December 1917, was promoted to First Lieutenant soon after arrival in France, and became Captain of a machine-gun batallion at the age of 23—a fine record, now sealed by actual fighting at the front.

C. B. Sprague died at Salt Lake City on June 7 in consequence of injuries received in an automobile accident. He devised the application of the bag-house for condensing fume from the copper-smelting furnaces at Murray and Midvale, in Utah, by suggesting the use of zinc oxide as a reagent to neutralize the corrosive substances that otherwise would destroy the bags.

Arthur R. Trench, business manager of the 'American Metal Market,' New York, for several years, and second son of C. S. Trench, of C. S. Trench & Co., metal-brokers, was accidentally drowned at Camp Petawawa, Canada, on June 1. Mr. Trench enlisted in the Canadian Field Artillery on May 1, 1917, and was promoted to sergeant in a few months. With many others of like rank, he was being retained in Canada for drilling recruits. He leaves a wife and three small children.

THE METAL MARKET



METAL PRICES

San Francisco, June 18

Aluminum-dust, large and small lots, cents per lb	65—70
Antimony (wholesale), cents per pound	15
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	8.07½—9.07½
Platinum, Government price, per ounce	$105
Quicksilver, per flask of 75 lb	$110
Spelter, cents per pound	9¾
Zinc-dust, cents per pound	17½

ORE PRICES

June 18

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38 to 48%, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton (nominal price)	$7.00—$8.00
Manganese, domestic, 35 to 54%, f.o.b. South Chicago, per unit (Government price, effective May 29)	$0.86—$1.30
Manganese, domestic, 35 to 54%, f.o.b. east of South Chicago, per unit (Government price, effective May 29)	$1.01—$1.45
(Manganese, domestic, penalty of 50c. to $1 per ton for 8% and up to 25% silica, and bonus of 50c. to $1 for less than 8 and 5%.)	
Molybdenite, per lb., 90% MoS_2	$1.25
Tungsten, 60% WO_3, California, per unit	$24

According to Albert Burch, Crocker Bdg., San Francisco, representing the U. S. Bureau of Mines in investigating chrome, production of California this year shows a falling off. Miners are notified that the Government is not buying chrome nor financing development of chrome properties, as there is no appropriation for this; but the Government is aiding stimulation of output by the present investigations.

EASTERN METAL MARKET

(By wire from New York)

June 18.—Copper is unchanged. Lead is inactive and nominal. Spelter is quiet though strong.

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to make prompt settlements with smelters and brokers, producers allow a discount from the Government price of $1, hence the lower price. The Government has not fixed the general market price at $1, but will pay this price (as from April 23, 1918) for all silver purchased by it. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the current rate of exchange.

Date	New York, cents	London, pence
June 12	99.50	48.87
" 13	99.50	48.87
" 14	99.50	48.87
" 15	99.50	48.87
" 16 Sunday		
" 17	99.50	48.87
" 18	99.50	48.87

Average week ending	
May 7	99.52
" 14	99.50
" 21	99.50
" 28	99.50
June 4	99.50
" 11	99.50
" 18	99.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57 89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	67.86	87.38	....
May	74.27	74.61	99.50	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67½c. for small lots, effective until June 1, 1918. On this date the prices were re-fixed until August 15, 1918. Quotations in cents per pound are as under:

Date	
June 12	23.50
" 13	23.50
" 14	23.50
" 15	23.50
" 16 Sunday	
" 17	23.50
" 18	23.50

Average week ending	
May 7	23.50
" 14	23.50
" 21	23.50
" 28	23.50
June 4	23.50
" 11	23.50
" 18	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25 66	29 67	....
Feb.	26 62	34.57	23.50	Aug.	27 03	27.42	....
Mch.	26.65	36 00	23.50	Sept.	28.28	25 11	....
Apr.	28 02	33 16	23.50	Oct.	28.50	23.50	....
May	29.02	31.69	23.50	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

Copper production of some of the large mines in May was as under, in pounds:

Anaconda	28,400,000	Kennecott	3,404,000
Arizona	4,130,000	Greene Cananea	4,100,000
Calumet & Arizona	4,768,000	Miami	5,100,000
Cons. Arizona	2,000,000	New Cornelia	4,404,000
Davis-Daly	750,000	Nevada Con.	7,000,000
East Butte	2,208,000	Old Dominion	3,239,000
Chino	5,987,000	Ray Con.	8,120,000
Braden	6,758,000	Shannon	802,000
Cerro de Pasco	6,166,000	Shattuck	841,000
Inspiration	10,250,000	Utah	18,200,000

Dividends declared are as under:

Company	Amount	Date	Previous amount
Chino	$1.00	June 29	$1.00
Nevada Con.	0.75	" "	1.00
Ray Con.	0.75	" "	1.00
Utah Copper	2.50	" "	2.50

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date	
June 12	7.45
" 13	7.50
" 14	7.50
" 15	7.55
" 16 Sunday	
" 17	7.82
" 18	7.82

Average week ending	
May 7	6.72
" 14	6.73
" 21	6.92
" 28	7.07
June 4	7.16
" 11	7.31
" 18	7.61

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.64	6.85	July	6.40	10.93	....
Feb.	6.23	9.10	7.07	Aug.	6.28	10.75	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	6.88	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

Lead ore is stronger at Joplin, Missouri, the top price, basis of 80% metal, being up $2.50 at $87.50 per ton.

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. On May 25, 1918, the Government fixed prices until September for grade A spelter at 12c. per lb. for itself and the open market. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c., and plate at 14c. per pound.

Date	
June 12	7.62
" 13	7.62
" 14	7.62
" 15	7.75
" 16 Sunday	
" 17	7.75
" 18	7.87

Average week ending	
May 7	7.09
" 14	7.21
" 21	7.41
" 28	7.50
June 4	7.50
" 11	7.56
" 18	7.70

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	7.29	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

The zinc-ore market at Joplin, Missouri, has been slightly weaker, no sales of second-grade, basis of 60% metal, being over $45 per ton.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date	
May 21	110.00
" 28	110.00

June 4	110.00
" 11	110.00
" 18	110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219 00	113 75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115 00	Oct.	78.20	102.00	....
May	90.00	104.00	110.00	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

In New Jersey last week, 350 flasks of quicksilver was stolen, so buyers are advised to investigate the origin of any odd lots offered them.

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	100.01	Nov.	44.12	74 18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

Vulcan Detining Co. reports for the first quarter of 1918 sales totaling $335,472, against $252,792 in this period of 1917. The net profit was $44,988, compared with $36,051.

ORES

Manganese: Indian ore has sold at a new high figure in the last week. One lot for forward delivery brought $1.40 per unit. April imports of manganese ore were larger than had been expected. They amounted to 58,023 tons, or next to the largest of any month this year, and contrast with 19,300 tons in March. It has been arranged that sailing vessels will carry coal to the Central Railroad of Brazil and that 35,000 tons per month of ore will be allowed to be imported from there.

Eastern Metal Market

New York, June 12.

Some markets have advanced. The general tone in all but tin is strong, yet there has been no pronounced activity in any.

Copper conditions continue unaltered.

Tin continues to ease, but transactions have been very light.

Lead has been heavily bought by the Government and is higher.

Zinc is stronger and higher on light offerings and transactions.

Antimony has been more active and is higher.

The distribution of the entire iron and steel output of the country has been put into the hands of J. L. Replogle, Director of Steel Supply, by order of the War Industries Board dated June 6. No one in the trade fully understands the order, says 'The Iron Age'. Starting with the sweeping provision that no pig-iron or steel products shall be shipped except under priority certificates, the order provides that after all priority requisitions have been filled producers may supply their customers if the latter are on a preferred list which is to be sent out later as revised. Producers have thus far no direct or official notification of the new order. It is a fact that no accurate estimate exists or can be made of the Government's steel requirements. One official estimate is that the Government will take at least 85% of the output for strictly war purposes. Steel workers have been puzzled by the numerous reports in the past week, even though promptly denied, that the Government would take over the industry in an operative way; yet the resolutions of the War Industries Board expressly provide for the continued co-operation of the steel manufacturers' committee.

COPPER

General gossip is about the only material available for this paragraph in these days of a strictly controlled market. There is no concealing the fact that there is a good deal of dissatisfaction over the refusal of the price-fixing committee to advance the price of 23.50c. for copper as of June 1. Many believe it was urgent in view of all the facts and some expect a re-adjustment by August 15, or perhaps before. Your correspondent ran across an interesting rumor yesterday: It was to the effect that a proposition is being seriously considered at Washington, as the result of a suggestion of some producers, that 15% of the copper output be permitted to be sold at whatever price it will bring, the remainder to be distributed at the Government price of 23.50c. per lb. It is figured that the 15% would sell perhaps as high as 35c. per lb., thus raising indirectly the 23.50c. price of the rest about 1.75c. per lb. This would be an interesting experiment, but it is hardly thought likely to be carried out. Many think that some change in price-conditions is probable before August 15. The copper producers are to have another meeting on August 7. Copper demands are and have been large, and it is stated that producers are quite a little behind on deliveries due by June 1. Consumers are clamoring for copper, and some sellers have booked orders until August 15 at 23.50c., while others have done so subject only to a revision of price. As far as received May exports of copper produced by the smelters compare favorably with that of March and are higher than that for April.

TIN

The market continues to decline, and is considerably unsettled at the present writing, due largely to the fact that between Saturday of last week and Monday of this week the Singapore price fell £23 per ton. As a result buyers are waiting. Late last week, or during the last three days, namely, Thursday, Friday, and Saturday, there was a little buying for future shipment from the Far East, which was sold at prices running down to 82c. per lb., which compares with transactions at 85c. a week ago. So far this week there has been practically no business reported. The spot market is nominal and unchanged at 90c., New York. The New York Metal Exchange reports tin arrivals from Pacific ports in May to have been 3210 tons, which, with the Atlantic port arrivals, makes the May deliveries total 4056 tons. The monthly average deliveries to June 1 this year have been 4459 tons, which compares with 3475 tons per month in the first seven months of 1914. Arrivals at Atlantic ports to June 11 inclusive, have been 275 tons, with 1300 tons reported as having come in at Pacific ports. Tin in London continues to decline. Yesterday spot Straits was quoted at £329 per ton, a decline of £17 per ton since last week.

LEAD

It has been expected for some time that the leading producers would advance its price. This took place the middle of last week when the American Smelting & Refining Co. advanced the price ¼c. per lb., that is, to 7.25c., New York. It is reported that that interest did sell a little lead at the new level, but later withdrew from the market. An important feature of the past week has been the large buying by the Government, which is stated to have purchased large quantities and to have cleaned up most of the available supply except that of a few outside producers. As a result prompt lead is more difficult to get than for some time. The fact that Government needs come first has restrained the few that still have some lead from offering. It is stated that some lead was sold first prior to the purchase by the Government at a higher level than the A. S. & R. price. The market is strong and higher at about 7c., New York, for early delivery. A Lead Producers' Committee for war service has been organized at the request of Bernard M. Baruch with Clinton H. Crane as chairman, and Edward Brush, F. Y. Robertson, Harry L. Day, T. Wolfson, L. Vogelstein, Julius Loeb, and A. W. Dodd as other members.

ZINC

On light offerings the market has continued to advance and the tendency is still upward. Prime Western for early delivery is quoted at 7.37½ to 7.45c., St. Louis, or 7.62½ to 7.70c., New York, with light sales made at these levels. Demand is not strong, but there is a disinclination on the part of certain producers to quote, or else they have not the metal for early delivery. The Government is a heavy buyer of grade A zinc continually, and much lower grade metal has undoubtedly been re-distilled into grade A. For the third quarter 7.50c., St. Louis, or 7.75c., New York, is asked for prime Western. Dealers are reported as having done some buying of prime Western.

Sheet zinc is fixed at a 15c. per lb. basis, with plate zinc at 14c. per pound.

ANTIMONY

The market has again taken on life, with sales reported running up to 1000 tons and more. As a consequence quotations are higher at 12.75 to 13c., New York, duty paid, for Chinese and Japanese grades for spot and early delivery.

ALUMINUM

For No. 1 virgin metal, 98 to 99% pure, and for scrap metal, Government prices rule as follows: For 50-ton lots, 33c. per lb.; for 15 to 50 tons, 33.10c. per lb., and for 1 to 14 tons, 33.20c. per lb., effective until September 1.

Book Reviews

Mining Engineers' Handbook. Edited by Robert Peele. Pp. X-2375, ill, index. John Wiley & Sons, Inc., New York, 1918. For sale by the Mining and Scientific Press. Price, $5.

This is the book that the mining engineers have been awaiting for many years. The civil engineers have had their Trautwine, the mechanical engineers their Kent, the electrical engineers their Pender, but the mining engineers have had nothing. The textbooks on mining were elementary compilations mostly of a general nature, and wholly unsuited to the purpose for which this new volume is designed. John Wiley & Sons have placed the mining world under obligations through their initiative in meeting so great a want, and they have been fortunate in securing the services of Mr. Peele as the guiding editorial spirit to translate the conception into achievement. His early experience in general practice in connection with important enterprises, and his long service as a professor of mining at Columbia University, have given him the right technical equipment and professional judgment for the task. The work is a compendium of many chapters contributed by a large number of the best known authorities. For example, the chapter on mineralogy is by Alfred J. Moses; that on geology and mineral deposits by J. F. Kemp; earth and rock excavation by Halbert P. Gillette; tunneling by D. W. Brunton and John A. Davis; prospecting, development, and exploitation by James F. McClelland; hoisting plant, shaft-pockets and ore-bins by William M. Weigel; drainage of mines by Robert Van Arsdale Norris; compressed-air plant by Richard T. Dana; electric power for mine service by George R. Wood; surveying by Charles B. Breed; underground surveying by Edward K. Judd; mine geologic maps and models by Reno H. Sales; mining laws by Horace V. Winchell; ore dressing by Robert H. Richards; ore sampling by T. R. Woodbridge; assaying by E. J. Hall; ore testing by J. E. Clennell and E. K. Judd; gold amalgamating and cyaniding by Edward L. Dufourcq; mathematics and mechanics by C. H. Burnside; hydraulics by J. K. Finch; engineering thermo-dynamics by Edward D. Thurston Jr.; steam engines, pumps, turbines, and gas engines by H. L. Parr, E. D. Thurston Jr., and A. L. Herrick; electrical engineering by Walter J. Slichter; and elements of structural design by J. K. Finch. We have selected only a few by way of illustration. The volume, as will appear from this, is widely inclusive, corresponding to that extraordinary variety of engineering talent that is demanded in the mining engineer; in fact, he is often referred to as 'all sorts of an engineer.' The scope is so broad that only by a corps of specialists could it be covered adequately. Previous attempts to provide a handbook have been restricted to narrow fields. No single author could compass anything as big as this. The present volume gives the data required by the practitioner as completely as the essentials of mechanical engineering are provided in Kent's invaluable handbook, or as the fundamentals of electrical engineering are presented in Pender's vade mecum. The art of mining engineering, and the chief contributory sciences, have been assembled for use in this valuable work. The ordinary questions arising in daily practice are answered with such fullness that only where problems of a special nature are involved will it be necessary to consult more extended treatises. It is in the best sense a ready assistant in the routine operations of the mine and the treatment-plant. The illustrations are particularly meritorious, being in most cases carefully executed working drawings, taken from the best practice. Formulas for the commonly recurring calculations in the various phases of engineering are given abundantly, together with the usual mathematical tables, logarithms, trigonometric functions, and other data of like nature. There is also a compendium of chemical notes and tables, and other chapters are devoted to sanitary engineering, welfare equipment, and the application of modern requirements for safety. The appearance of this book is an event of real importance, and it will be heartily welcomed by the profession.

Sulphuric-Acid Handbook. By Thomas J. Sullivan. Pp. XIII, 239, index. McGraw-Hill Book Co., Inc., New York, 1918. For sale by the Mining and Scientific Press. Price $2.50.

Never before has so great a popular interest been taken in sulphuric acid; this is because the demand has grown to such enormous proportions as a result of the War. Indeed it has grown far beyond the capacity of the equipment available. It is not long ago that firms in the East, including some of the greatest chemical manufacturers in the world, were forced to place orders in San Francisco for acid in carload lots at a spot price of $125 per ton. The fact that now, when the demand is even greater, the price of acid in the East is about $25 per ton for the 60°B. grade, constitutes a measure of the response that has taken place in the building of new plants since 1916. No good modern textbook on the manufacture of acid has been available to meet the demand occasioned by the increasing interest in this branch of technology. Lunge's standard work is a monumental treatise, but it cannot be said to represent the details of the industry as practised at the leading plants today, where modern engineering has been applied. A book on the subject by Mr. Sullivan, who is an acid expert connected with a subsidiary of the New Jersey Zinc Co., will be widely welcomed. It is essentially a vade mecum for the work's chemist; giving elaborate tables of specific gravities corresponding to readings by Baumé and Twaddle hydrometers; acid-tables for sulphuric, nitric, and hydrochloric acids; physical constants of sulphuric acid; specific gravity and per cent of free SO_3 as units in fuming sulphuric, and equivalents in H_2SO_4 as units; testing for specific gravity; acid calculations; definite acid mixtures, or so-called 'mixed acids'; melting and freezing points of sulphuric acid; tension of aqueous vapor; determination of SO_2 in burner gas; qualitative and quantitative analyses of sulphuric acid; calibration of storage tanks, and a large number of tables of areas, volumes, weights and measures, and the like, including tables of anti-freezing liquids. Some of the latter tables are so readily accessible in general engineering and chemical handbooks that their insertion here may seem superfluous, especially since space has not been given to some features that we think would have been appreciated, such as structural details of towers, chambers, coolers, and the multitude of special appliances found in an acid-plant. We think these would be useful, as well as data on pyrite and sulphur-burning; fan performance, flow of gases of varying composition through flues, cooling towers, and so on. Moreover, it would add to the completeness of the manual to have a brief outline of procedure in the manufacture of chamber and of contact acid, as well as the technique of acid-concentration. It is an admirable book, and meets a real want. That it might be added to advantageously does not minimize the fact that it stands quite alone in its field, and that the student and practical acid-maker will here find assembled the information required to make easier the work in the plant and in the laboratory.

Tabular Classification of Igneous Rocks. By Victor Ziegeler. Department of Geology, Colorado School of Mines.

This is a small wall-sheet or diagram, showing 134 rock species. It is in the form of a key, based upon co-ordinates showing on the abscissas the facies and mode of occurrence, and on the ordinates the mineralogical composition, together with the accessory minerals and the average chemical analysis. It is exceedingly simple and useful.

Company Reports

ANACONDA COPPER MINING CO.

Property: copper and zinc mines at Butte, reduction works at Anaconda and Great Falls, refinery and rolling-mill at Great Falls, coal mines and lumber mills, etc., all in Montana. Also the company controls the International Smelting Co., International Lead Refining Co., and Raritan Copper Works, operating smelters and refineries. In South America two subsidiaries, the Andes Copper Mining Co., and Santiago Mining Co., are developing mines.

Operating Officials: the list is so long that space is not available in this review of operations during 1917.

Financial Statement:

	1917	1916	1915
Sales of metal	$109,055,593	$96,097,709	$61,473,677
Gross receipts, inc. metal on hand.	156,205,157	148,190,046	87,273,886
Disbursements	118,706,777	91,647,708	67,806,191
Balance	$37,498,380	$56,542,338	$19,467,695
Income from investments	2,749,083	2,350,641	112,922
Interest paid	526,275	951,144	984,233
Depreciation	5,387,437	7,113,463	1,900,578
Profit	$34,333,751	$50,828,372	$16,695,806
Dividends	19,815,625	17,484,375	9,325,000
Surplus	14,518,126	33,343,997	7,370,800
Profit and loss surplus	62,913,988	48,395,862	15,051,865

Current assets total $71,328,647, including $32,966,589 for metals in process and on hand. Current liabilities amount to $36,065,119.

Dividends: No. 66 to 70 were paid during 1917, amounting to $19,815,625. Including $4,662,500 paid in April 1918, the total to date is $142,370,000.

Development: labor disturbances starting in June lasted well on toward the end of the year, seriously curtailing all operations. New work covered 34.61 miles underground, a decrease of 7.35 miles. Shafts were sunk depths aggregating 2089 ft. Results generally were very satisfactory. New head-frames, hoists, compressors, and other machinery was erected. Ventilation of the entire property is under way, and electric fans were installed having a capacity of 696,100 cu. ft. of air per minute. Shafts were fireproofed with metal laths and cement. The mines produced 4,193,624 tons of ore and 10,012 tons of copper precipitate.

Reduction Works: the various plants concentrated and smelted on company account 3,906,901 tons of copper ore, 17,130 tons of precipitate, and 257,850 tons of zinc ore. These yielded the following metals: 239,014,880 lb. copper, 50,624,524 lb. zinc, 8,368,180 oz. silver, and 58,545 oz. gold. This is a decrease of 67,000,000 lb. copper, 2,400,000 oz. silver, and 33,000 oz. gold, but an increase of 30,000,000 lb. of zinc.

General: The copper-leaching plant treated 598,370 tons of tailing, yielding 5020 tons of cement copper. A satisfactory method has been evolved for treating the complex residue from the zinc-leaching plant. The acid plant was enlarged by 50 tons daily. A new 525-ft. stack is being built of brick made from flotation residue. The 100-ton copper rod and 80-ton copper wire mill is now in operation. Manganese ore is being mined and sold. The company's coal mines yielded 1,055,000 tons, and the saw-mills cut 87,330,000 ft. of lumber. The Butte, Anaconda & Pacific Railway carried 6,800,000 tons of freight and ore, and 355,224 passengers.

A brief review of the subsidiary corporations reveals the following:

International Smelting Co.

The smelter at Tooele, Utah, treated during 1917, 320,510 tons of copper ore and 334,274 tons of lead ore, from which there were produced 17,385,090 lb. of fine copper, 84,726,315 lb. of fine lead, 4,439,290 oz. of silver, and 31,495 oz. of gold.

The smelter at Miami, Arizona, treated 242,936 tons of concentrates and 26,839 tons of purchased ores, a total of 269,775 tons, from which there were produced 138,762,411 lb. of fine copper, 201,860 oz. of silver, and 2954 oz. of gold.

International Lead Refining Co.

The refinery at East Chicago, Indiana, treated 41,682 tons of lead bullion from the Tooele plant, and 23,558 tons of purchased ore and bullion, from which there were produced 117,922,724 lb. of common and corroding lead, 11,525,365 lb. of antimonial lead, 5,259,738 oz. of silver, and 24,673 oz. of gold.

Raritan Copper Works

The refinery at Perth Amboy, New Jersey, treated for all companies during the year 209,557 tons of copper bullion and 5,806,924 oz. of silver bullion, from which there were extracted 411,933,742 lb. of fine copper, 19,938,375 oz. of silver, and 137,465 oz. of gold.

Andes Copper Mining Co.

The property consists of 5301 acres in Chile.

Sixteen drill-holes were finished during 1917, aggregating a total depth of drilling of 12,000 ft. showing an addition to previously developed ore of 5,434,081 tons of an average grade of 1.5411% copper. A shaft 90 metres deep was sunk and 3750 ft. of tunnels were driven in the main orebody to check prior sampling.

It is estimated that there will be 1500 employees, and provision is being made to house them in a comfortable and sanitary manner, in addition to which churches, schools —both American and Chilean—office buildings, etc., are under construction.

The Quebrada pipe-line, consisting of a 3-in. steel line 17 miles long, with terminal reservoirs, was brought into Potrerillos for the purpose of supplying the camp. The Asientos pipe-line, of different pressures, aggregating a total of 96 miles, bringing in the water supply to Barquito for the purpose of supplying the railroad, was completed. Construction progressed on La Ola pipe-line, about 35 miles long, which is to bring water to the mill-site for the purpose of operating the concentrator when completed.

The Potrerillos railway transportation system has been divided into four sections, namely: (1) wharf at Barquito to intersection with State railway of Chile, 2.85 miles; (2) junction with State railway to Pueblo Hundido (this section is owned by the Chilean government), 38 miles; (3) Pueblo Hundido to mill-site, 56 miles; and (4) mill-site to mine, 5.5 miles.

The last section is to be an electric railway, of which 2 miles will be the main adit of the mine, and 1.2 miles branch tunnels. The grade of this system will be uniformly 0.3 of 1%, starting over the storage-bins of the mine at an elevation of 9700 ft., and the mine end will be 1000 ft. below the surface. All these roads will be one-metre gauge. Of this system, the Barquito wharf, port works, and first section of railway were completed last year. Of the section from Pueblo Hundido to mill, grading for 45 miles was completed and 8 miles of track laid. Of the last 11 miles, the estimated amount of material to be moved is 335,000 cubic metres, and 11 tunnels are to be driven, aggregating 5850 ft.; 164,351 cubic metres, or 49% of material, was moved, and 910 linear feet of tunnels, or 15.5%, completed during the year. Of the mine tunnels forming part of this system, the following percentages were completed during the year: No. 1, 17.5; No. 2, 56; No. 3, 72.4; and main adit, 7.4%.

Santiago Mining Co.

As part of the activity of the exploration organization operating in South America, options had been secured upon Lo Aguirre mines, situated 20 kilometres west of the City of Santiago, Chile. The mines consist of five groups, comprising 500 acres, part of which were acquired by purchase from former owners and part by denouncement. The ore

occurs as a disseminated deposit. Development was begun in March 1914, and by the summer of 1917 there had been developed more than 6,000,000 tons of ore carrying from 1.75 to 3.5% copper. The average of all tunnel samples was 2.44%. The ore is of mixed sulphide and oxide character. It is believed that the orebody contains a much greater tonnage, estimates having been made showing the probability of 16,000,000 tons, but a little over 6,000,000 is all that was, at the close of the year, definitely developed.

Options had also been secured upon practically the entire ownership of the Africana mines, 3 miles east of Lo Aguirre mines. Here the ore occurs in vein formation. The mine was developed by means of a shaft to a depth of 220 ft., and by underground workings having a lateral extent of 350 ft., also by 12 diamond-drill holes intersecting the vein at undeveloped points varying in depth from 50 to 388 ft. The ore is high grade, running from 4½ to 9%, and is particularly desirable on account of its excess sulphur content, which, manufactured into sulphuric acid, can be used for leaching the oxidized ores of Lo Aguirre mines.

Comprehensive tests were made on ores from the above properties, and a combination leaching, concentrating, and smelting method that will give satisfactory results has been decided upon.

When the development of the above mines had progressed to a point where it was deemed prudent to do so, the decision was made to secure title to these properties. The Santiago Mining Co. was organized under the laws of the State of Delaware. The authorized capital $10,000,000, divided into 400,000 shares of the par value of $25 each.

The Anaconda company will, from time to time, as it becomes necessary, advance funds for the requirements of the Santiago company, taking its stock at par for such advances. Upon the completion of the financing of the company, Anaconda will own approximately 80% of the issued stock of the Santiago, the remainder will be owned by William Braden and his associates under the contract between them and the Exploration organization of Anaconda. The plan of initial development adopted contemplates the development of Africana to a production of 500 tons of ore per day and of Lo Aguirre to 750 tons. Development of orebodies is being continued, but construction of mining and metallurgical works has been deferred until the resumption of normal conditions.

MOUNT BISCHOFF TIN MINING CO.

Property: mines and mill at Waratah and smelter at Launceston, Tasmania. One of the world's greatest tin mines.

Operating Officials: J. D. Millen, general mine manager; F. B. Jackson, smelter manager.

Financial Statement: for half-year ended December 31, 1917, tin realized £39,091 ($191,000). Of this, £12,472 $60,000) was profit. Balance at June 30 was £88,533 ($423,000), and end of 1917, £84,284 ($403,000).

Dividends: £6000 ($28,800) was distributed, making £2,475,000 ($11,880,000) to date, equal to $990 per share.

Development: nearly all work is on the surface. Reserves are 1,250,000 tons of 0.301% (6 lb.) tin ore.

Production: the new mill, aerial trams, power-plant, and smelter are in good order. There was concentrated 52,655 tons, giving 219 tons of concentrate. This yielded 301,461 lb. of 99.87% tin. All costs were $1.82 per ton.

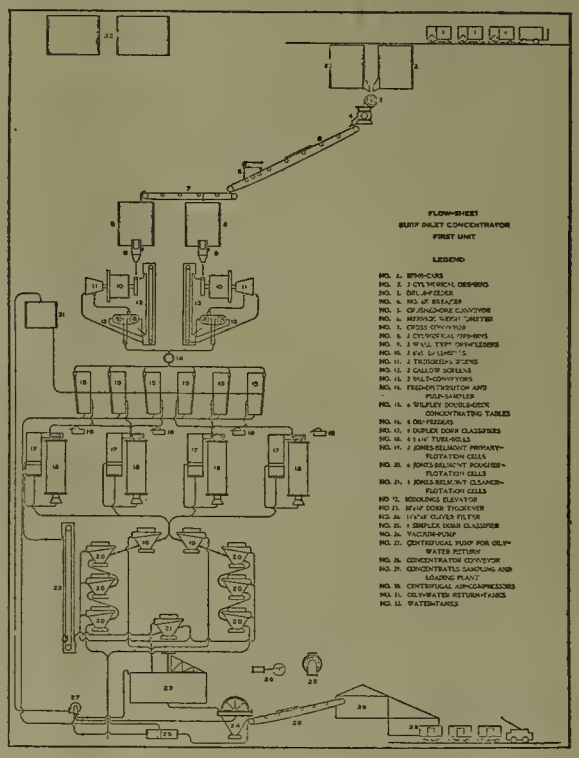
BELMONT SURF INLET MINES, LTD.

Property: gold-silver-copper mines and mill at Surf Inlet, Princess Royal island, British Columbia.

Operating Officials: F. W. Holler, superintendent; H. J. O'Connell, mine superintendent; F. H. Penn, mill superintendent; E. W. Hawkins, auditor.

Financial Statement: from September 1, 1917, to February 28, 1917, the revenue was $325,792. Operations cost $239,637, leaving a profit of $86,154. Current assets total $326,258, and liabilities $200,233, including $168,215 due the Tonopah Belmont company of Nevada.

Development: during the year ended February 28, 1918, there was 3256 ft. of work done, making 12,329 ft. to date. The plant was complete enough to start milling on September 1, but a hurricane on November 2 wrecked the conveyor-bridge which carries ore to the mill from the crushing plant. Most of the development was done between the



Flow Sheet of the Mill at Surf Inlet, British Columbia

200 and 550-ft. levels. Reserves are in excess of the 385,320 tons estimated on March 1, 1917.

Production: the mill treated 33,207 tons of ore, assaying 0.501 oz. gold, 0.354 oz. silver, and 0.194% copper, valued at $11.106 per ton. The recovery was 92.09%. Concentrate—2964 tons—contained 15,262 oz. gold, 9870 oz. silver, and 129,138 lb. copper. Costs totaled $8.433 per ton, which will be lowered during the next year.

Generally the new equipment is working satisfactorily.

PORCUPINE-CROWN MINES CO.

The report of this Porcupine company shows that in 1917 it earned a profit of $132,448, of which $120,000 was paid in dividends. The balance on January 1, 1917, was $277,129, and on December 31, 1917, $265,206. Development amounted to 2166 ft., also 1260 ft. of drilling, nearly all below the 500-ft. level. No discoveries were made. There is only one shoot at depth instead of two above. Reserves are 600,000 tons, valued at $610,000. Owing to general conditions it was decided to curtail production, to carry on development only, and to suspend dividends. The mill treated 32,722 tons of $10.97 ore, of which 97.09% was extracted at a total cost of $7.07 per ton.

INDUSTRIAL PROGRESS

INFORMATION FURNISHED BY MANUFACTURERS

THEORY AND PRACTICE WITH PERIPHERAL DISCHARGE BALL-MILLS

By Pierre R. Hines

*There is a prevailing impression that the ball-mill is a recent development; however, ball-mills were used in Montana and other Western States as far back as 1898. The first successful ball-mill for wet crushing, which is still in operation, was built 10 years ago. This was designed by Erminio Ferraris for crushing Sardinian ores for concentration. It embodies the peripheral discharge with grates, large forged-steel balls, and the principal features of the modern ball-mill. The results approach present-day practice, the chief differences being that the mechanical construction has been improved in the modern types.

Crushing Action of Ball-Mill. The action of the balls, and the principles of crushing, have been studied by several investigators, especially Hermann Fisher, and Walford R. Dowling. Their conclusions are confirmed by results obtained by myself in experimenting with a small machine built at the Allis-Chalmers factory. A ball-mill may be revolved so fast that the balls will cling to the shell during the entire revolution, while at slow speeds they will be carried up only a short distance before they roll back. On the other hand, at the critical speed, they will cascade as shown in Fig. 1. At the critical speed the balls ascending

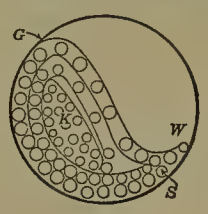


FIG. 1.

on the layer next to the shell start from rest at a point S and cling to the shell without revolving or rolling, which has often been ascribed to them. These balls are held at rest by centrifugal force until they reach a point G, the position of which is dependent on the speed of rotation. Beyond the point G, gravity overcomes centrifugal force and the balls fall with increasing velocity in a parabolic curve which is the resultant of the above two forces, striking at a point W, the force of the impact being expended in crushing the material. The several layers of balls lying on top of those next to the shell follow a similar cycle except that their paths become more nearly vertical. The outer layers, spreading more than the inner layers, increase the area in the zone of the falling balls. Within the circuit thus formed is a neutral axis or a sluggishly rotating kidney-shaped mass, in which little actual work is performed. The material being crushed is thoroughly distributed throughout the mass by filling the interstices between the balls, and follows in the same circuit. It is therefore evident that the material is crushed mainly by the impact of the striking balls as the whole mass falls. There can be little grinding by attrition from the rotation of balls, except at the point S where the shell picks up the mass and

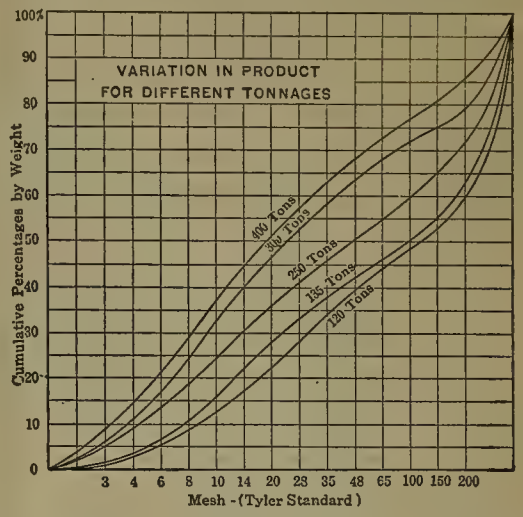


FIG. 2.

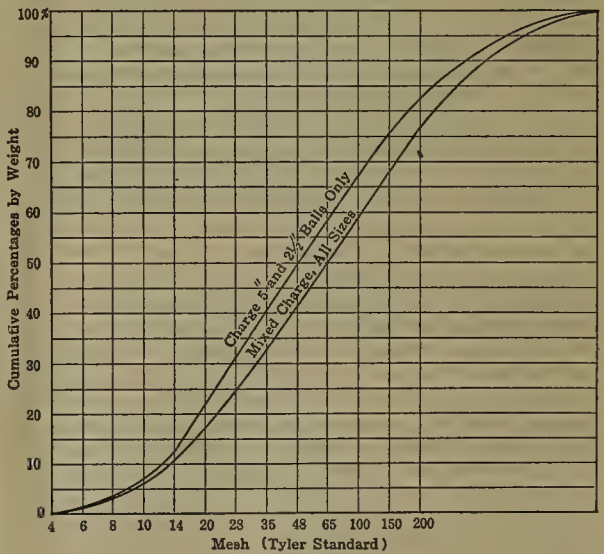


FIG. 3.

accelerates it to the rotative speed of the shell. The argument has often been advanced that fine material cannot be produced by impact alone and that fine grinding is done entirely by attrition or rubbing of adjoining balls. It is

*Abstract: Trans. A. I. M. E., 1918.

only necessary to break a few small pieces of rock on an anvil with a hammer to prove that fines are unavoidably produced by impact. Screen analyses of the discharges from tube-mills in open and in closed circuits lead to the conclusion that in many instances a fragment of ore may pass through the mill six to eight times before it is crushed to the desired fineness. Quoting directly from an article by Hermann Fisher on this subject: "The grinding action, therefore, depends upon the height of the drop of the balls, that is, the height of the curve-vertex above the point where the ball strikes, the speed of the shell, the weight and the

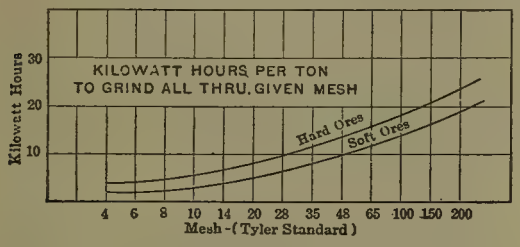


FIG. 4.

number of balls. The speed of the drum must be so determined that the curve can develop themselves properly. The weight of the balls and the height of drop are interrelated and their product must be sufficient to break the ore according to its size and hardness. Hard materials require heavier balls or greater height of drop than soft ones,

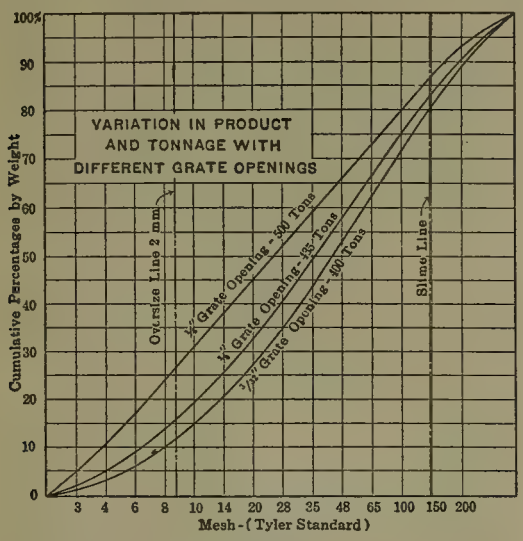


FIG. 5.

and steel balls in small-diameter cylinders will do the same work as flint pebbles in large-diameter cylinders."

The free fall of the balls is dependent upon the volume of the ball-load. With a charge equal to or greater than half the volume of the mill the free fall of the balls is decreased, the charge is held together, and the size of the inactive kidney-shaped mass is increased. When the charge is about one-third of the volume of the mill the size of the kidney-shaped mass is reduced and the balls fall from the maximum free height. Operating results bear out the above facts in that the greatest number of tons crushed to a certain mesh per kilowatt-hour are obtained with ball-charge equal to approximately one-third the volume of the mill.

Conditions Determining Fineness of Crushing. There is a general impression that the grate acts as a screen or sizer. This is true to a limited extent, but it is not of primary importance. The fineness of the product delivered by a ball-mill, when the size of feed, ball-charge, and speed remain constant, depends upon the tonnage fed, the density of the pulp (ratio of water to solids), size of balls, and, when operating in a closed circuit, on the efficiency of the external classifying apparatus. The screen analyses plotted in Fig. 2 show the effect of varying tonnages, other factors remaining constant. They are from results obtained with a 6 by 4-ft. mill.

The experience of operators at two Western plants verifies the statement that an assorted charge, containing a

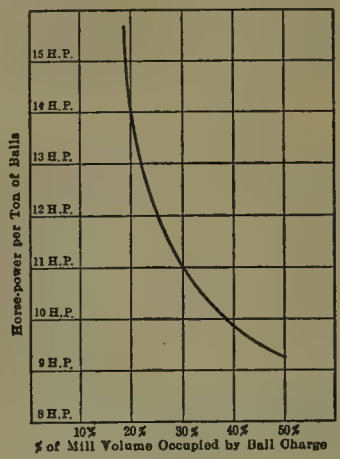


FIG. 6.

certain percentage of small balls, is desirable for a fine product.

The screen analyses plotted in Fig. 3 show the difference in product when the initial charge included only 5-in. and 2-in. balls, and when the same charge contained a larger percentage of 4, 3, and 2-in. balls.

The peripheral-discharge mill differs from a trunnion-discharge mill, in the character of its product in that a

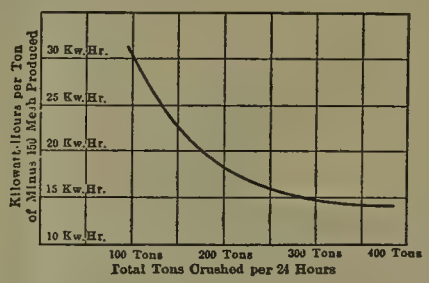


FIG. 7.

small amount of moisture will give a fine product and a large amount a coarse product. As the discharge is entirely at the periphery, and does not depend upon any classifying action to overflow the finished product, the greater the amount of water added the quicker the pulp will pass through the mill and the coarser the product. In mills provided with means for raising the discharge or pulp-level from the periphery to some intermediate height between the periphery and the trunion, the fineness and the amount of oversize can be controlled within certain limits. No figures are available showing these differences, but from practical results in the field it appears that a wide variation can be obtained by this means. The grate should, of course, retain some oversize, but this action can be carried to extremes. In all cases when a fine product is desired, it is advisable to run the mill in closed circuit with an efficient classifier. The principal function of the grate is to retain

the ball-charge in the mill, while permitting a peripheral discharge. The efficiency of the classifier, when a ball-mill is run in closed circuit, directly affects both the tonnage and the fineness.

Conditions Affecting Ball-Mill Capacity. The capacity of ball-mills depends upon the fineness of grinding, the weight or volume of the ball-charge, the hardness of the material, the size of the grate openings, and the size of the balls, all other factors remaining constant. The most important limiting factors for capacity have been the size of the feed-opening in the trunnion, the type of the trunnion-liner, and the type of the feeder.

A ball-mill has a certain definite maximum power-rating, depending upon its ball-load. Multiplying the kilowatt-hours per ton by the tons required to be crushed per hour, the product will represent the power required, and the mill nearest to that power-rating should be selected. Fig. 4 is a preliminary power-curve based on the recommended maximum ball-charge, together with all available data at hand at the present time. Operating a mill at less than its maximum capacity for a given ball charge will result in excessive wear on lining and balls and produce a finer product than necessary.

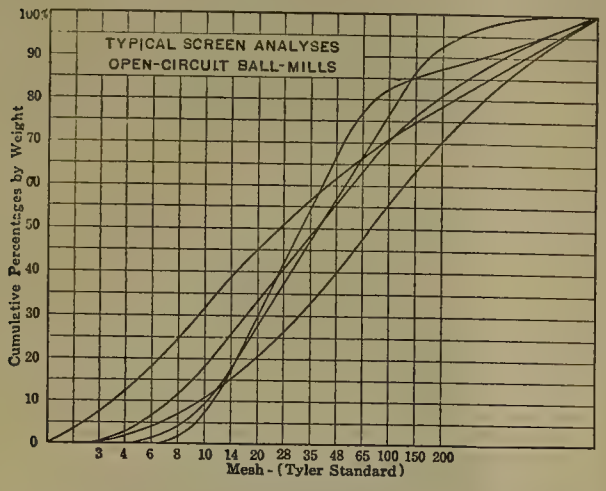


FIG. 8.

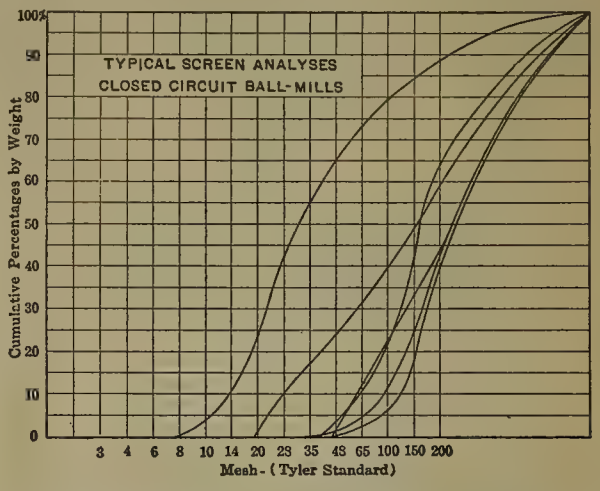


FIG. 9

Hard ores, when fed direct from a crusher, require a proper proportion of 5-in. steel balls to do effective work. A 4-in. steel ball is often sufficient for some of the softer porphyry ores. Smaller steel balls may be used for re-grinding, but the charge should contain a percentage of 2-in. steel balls when working on hard ores. For re-grinding soft ores, cast iron or composition balls may be used where the cost is important. Where a fine product is desired, with a minimum oversize, the grate opening should not be diminished; it is advisable to depend on an external classifier and operate the mill in closed circuit. Where a coarse product is desired, the grate may be used as a sizer and an open-circuit scheme adopted. Fig. 5 shows a typical example of the variation as to both tonnage and product that can be obtained with different grate openings.

Conditions Affecting Ball-Mill Power. Power depends principally upon the weight of the ball-charge, an approximate figure being 9 to 10 hp. per ton. However, the power per ton of balls will vary according to the percentage of volume that the ball charge occupies in the mill. An approximate curve from data at hand is given in Fig. 6, from which it will be seen that the power required per ton of balls is least when the mill is loaded half full, and that the curve rises rapidly as the ball-load is reduced. When the volume of the ball-charge is reduced, within certain limits, the power consumption per unit of ball-charge is increased, because the centre of gravity of the charge is further from the axis of the mill; but as the mass of balls is more active, the crushing efficiency is increased proportionately to the increase in power consumption per ton of ball-load. The curves (Fig. 7) plotted from recent tests show the power required per ton of material crushed under varying capacities.

Special Fields for Ball-Mill Crushing. The ball-mill is not to be recommended for all conditions. It is not suitable in preparing ore for concentration where the ore contains a large amount of coarse mineral that is easily pulverized. Where crushing to 12-mesh and finer is necessary to release the mineral, the ball-mill makes a suitable product. The installation of concentrating tables within the mill-circuit, as practised at Stoddard, Arizona, is a notable advance. The special field of the ball-mill, however, is for products of 20-mesh size and finer. The use of ball-mills for reducing product from the crusher so that 85% will pass a 200-mesh screen, using two-stage crushing, as practised at the United Eastern, Tom Reed, and Montana mines, in Arizona, is a distinct advance in fine crushing. While there is not such economy in power nor so small a number of repairs as compared with a stamp-battery and tube-mill plant of the same capacity, the operating troubles and attendance are much reduced. The curves in Fig. 8 and 9 show typical screen-analyses of ball-mill products.

Ball-Mill Feeding. The most desirable method of feeding coarse material is the arrangement adopted at the Tom Reed mill. The product from the crusher is fed direct from a bin to an apron feeder, the speed of which is controlled by a Reeves variable-speed transmission device, having a small hand crank, sprocket, and chain conveniently situated for the mill operator, insuring absolute control and allowing quick changes to be made.

When a ball-mill, having a proper crushing-load, is rotated at the critical speed, the balls strike at a point on the periphery about 45° below the horizontal diameter, or S in Fig. 1. An experienced operator is able to judge by the sound whether a mill is crushing at its maximum efficiency. Excessive rattling denotes under-feeding; a sound of impact at W (Fig. 1) indicates overloading; while, under proper conditions the impact will be heard near S. When a ball-mill fitted with a diaphragm is over-fed, the mill fills to a certain level, then stops crushing and discharges any additional feed back through the feed-trunnion. Once over-fed, it takes from 30 min. to 2 hr. to free itself. Ball-mills, therefore, should be provided with a central opening

in the diaphragm connecting with the discharge trunnion, to prevent over-feeding and the delays incident thereto. The greatest difficulty in feeding most ball-mills, when running on large tonnages and coarse feed, that is ½ to 3 in., is due to the restricted area of the feed-trunnion, which limits the quantity of the coarse material that can be fed. The average spiral in the trunnion-liner does not advance the feed rapidly enough; therefore, it retards the feeding. These results are confirmed in practice. A smooth liner, tapering from the feeder into the mill, does not retard the flow of the feed, and is, therefore, more efficient than the spiral. A short trunnion with large diameter is essential for feeding a large tonnage to a ball-mill.

The engineering department of the Allis-Chalmers Manufacturing Co. has recently conducted experiments with feeders modeled after the various types in use, on a scale of 1 in per foot. The feeders were operated at constant speed, conformable to present practice, the material delivered in a given time being weighed. The conclusions drawn were: "The intake of a single-scoop feeder has far greater capacity than the throat or trunnion of the mill, and there is no good reason for using a double or triple-scoop feeder, the capacity of the feeder not being controlled by the quantity it will pick up, but by the quantity that it can discharge through the throat or trunnion." These experiments demonstrated that the capacity of a spiral feeder is in direct proportion to the length of the path of the spiral. In other words, a spiral feeder embodies all the principles of the Frenier sand pump, in which the long path of the spiral increases the pressure which forces the feed into the trunnion opening. Fig. 10 shows a double-scoop feeder without a partition; Fig. 11 shows the same feeder with the two spirals connected across the centre of the trunnion-opening, making a partition so that the material cannot drop from one scoop in to the other. Fig. 12 shows a single-spiral feeder; Fig. 13 shows a triple-spiral feeder; and Fig. 14 shows a standard combination feeder which has a single spiral. Disregarding the influence of the trunnion liner, as determining the relative capacity of feeders, the experiments demonstrated that No. 12, the single-spiral feeder, has the greatest capacity; No. 11, double-spiral feeder with the partition across the trunnion opening, gave the next best capacity, which, however, was less than 50% that of No. 12. The capacity of No. 10 was only about 25% that of No. 12. The capacity of the triple-scoop feeder, Fig. 13, was but little greater than that of No. 11. Increasing the number of spirals or scoops does not add to the capacity of a feeder.



FIG. 11 FIG. 10 FIG. 12

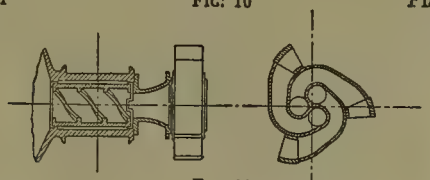


FIG. 13

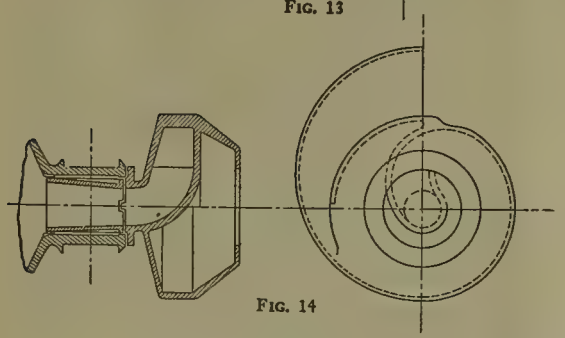


FIG. 14

FIGS. 10 TO 14.

Consistence of Pulp. The ratio of moisture to solids is important in ball-mill work. It has been observed that fine grinding is done best when the water constitutes 33 to 40% of the pulp. Where a minimum of fine material is desired, 50% and upward of water is desirable.

Ball Consumption. Ball consumption varies with the fineness of the product, the hardness of the ore, the quality of the ball, and whether a mill is run in closed or open circuit. The ball-consumption for mills delivering a coarse product, all passing 8-mesh and containing 10 to 20% below 200-mesh, the mill being run in open circuit, is about ½ lb. per ton for steel balls, and 1 lb. for cast-composition balls. The average ball-consumption for mills in closed circuit has been plotted in Fig. 15 for steel balls and for cast-composition balls. It should be noted that the curves apply to products practically all of which are finer than the meshes indicated, up to 65-mesh. Points on the curves representing finer products are for mills generally re-grinding 10 to 20-mesh feed; hence corresponding amounts must be added to give the total ball-consumption for reducing from crusher size to 100-mesh and finer.

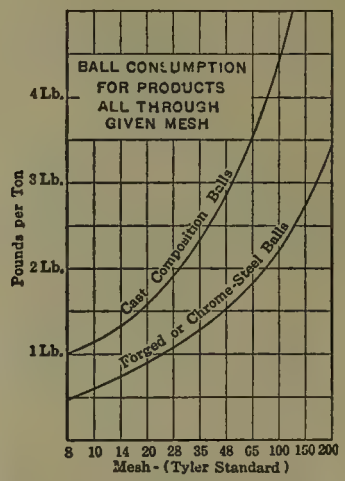


FIG. 15.

Consumption of Liners. The average consumption of shell-liners, for both chrome and manganese steel, is ⅓ lb. per ton of ore crushed. The consumption of lining seems to be fairly constant regardless of the hardness of the ore, fineness of product, or other conditions. The greatest wear is probably caused by the impact of the balls and by their slippage on the shell during the period of acceleration. If the mill is running below capacity the wear will increase. The greatest improvement made recently in liners is the increase in weight and thickness. There is considerable difference of opinion regarding the shape of liner. The smooth liner is probably as efficient as any if run at a slightly higher speed. Hard-iron liners have not been found satisfactory with balls of 5 and 4-in. diameter. They fail by cracking and breaking, but with balls of 2-in. diameter or less they are sufficiently durable.

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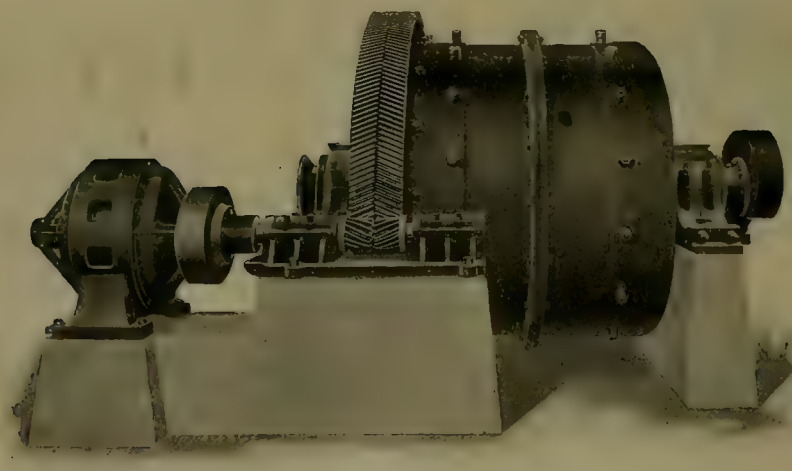
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No. 6½ (6 ft. inside dia.) Marcy Mill, direct connected to motor.

MARCY MILLS

—*for Producers of Tungsten*

Mineral and gangue have an equal chance to escape from the Marcy. This has been proven by actual operation. It means a small amount of slimes and an increase in general extraction. We quote from a letter received from Mr. Cooper Shapely, Manager of the Round Valley Tungsten Company, dated Sept. 18th, 1917, as follows:

"It might be well for you to know that the mill (No. 53) is grinding about 90 tons daily and making only 12% passing through 200 mesh. Of this 12% there is 5% already in the ore when it leaves the mine."

We are now filling a repeat order for this Company.

The Marcy Mill is a cylindrical type of ball mill developed to a high degree of efficiency. It is equipped with a grate covering the entire discharge end, and which gives the Marcy a greater actual discharging capacity than any other mill. For crushing tungsten-ore the Marcy is ideal. It is also extensively used for crushing molybdenum and graphite-ores. In their reduction the Marcy Mills take feed directly from primary crushers and reduce it, in ONE EASY STEP, to flotation size.

Large Capacity, small floor space, and high crushing efficiency concentrated into a compact mill give the Marcy its supremacy.

Among the Tungsten Producers using Marcy Mills for doing their grinding are the

Atolia Mining Company
Standard Tungsten Company
Salt Lake Tungstonia Company
Wolf Tongue Mining Company

An item of interest: **The Phelps-Dodge Corporation has just purchased a No. 86 Marcy Mill for their Moctezuma plant**

Write for new Marcy booklet No. 42, and give tonnage and character of your ore.

THE MINE AND SMELTER SUPPLY COMPANY

Denver **Salt Lake City** **El Paso**

New York Office: 42 Broadway



EDITORIAL

SPELTER production was accelerated in 1916 and 1917 to such a degree as to surfeit the market and exceed consumption, the consequence being an inevitable slump in the price. The logic of events has forced producers to co-operate with a view to regulating production, and this has been done despite the Sherman Anti-trust law, with the cognizance of the authorities at Washington, themselves anxious to prevent the further demoralization of the zinc industry. Mr. C. E. Siebenthal, specialist on zinc to the U. S. Geological Survey, has written a letter, approved by the Secretary of the Interior, recommending a discontinuance of production in the lower grades of spelter for several weeks, at least, in order to stiffen the market.

CHUQUICAMATA'S development has been hit hard by the War, which diminished the amount of shipping available for exporting copper and for importing the necessary supplies. The Chile Copper Company, which owns the great mine in Antofagasta, had to raise $17,665,000 by a bond issue in 1917, bringing the total bonded indebtedness to $32,665,000, all of which has now been spent. The Guggenheims were clever in keeping the stock and in persuading the public to buy the bonds wherewith to finance the development and equipment of the property. As yet no dividend is in sight, the earnings last year being $1.43 on the 3,800,000 shares. In 1917 the production was 89,022,126 pounds of copper, at a cost of 13.2 cents per pound, as compared with 10,944,000 pounds at a cost of 18.55 cents per pound in 1915. This suggests what progress has been made in two years, but it is "a long, long way" from the 4-cent copper of promotion days. Even the War cannot be blamed for all of the shortcoming. We appreciate the difficulties of technical men when they are expected to make good the flamboyant predictions of cheerful financiers.

PULVERIZED coal is being tried in the blast-furnace smelting of copper ores at the plant of the Tennessee Copper Company. Full details have not come to hand, but it appears that the firing of the coal-dust is done through alternate tuyeres. The consumption of coal is said to be 3% of the weight of the charge, whereas 6% of coke has been used heretofore in the semi-pyritic practice at Ducktown. The advantages to be gained by employing coal-dust are easy to see. If successful, it would afford an economy in fuel, it would admit of close regulation of the ratio of fuel to air so as to provide the correct proportion of carbon monoxide needed as a reducing agent, with a correspondingly high temperature at the point where it is most desired; furthermore the gases would be free from unconsumed carbon. At the same time the volume of gases issuing from the furnace would be reduced, thereby proportionally increasing the content of sulphur di-oxide. As a result a cleaner and richer sulphurous gas would be available for use in the sulphuric-acid plant, which is so important an adjunct to the Tennessee Copper Company's smelter. After a trial of two weeks the indications were favorable for overcoming the minor difficulties experienced at first, and the new method may be adopted as routine practice.

'WORK or fight' was the decree that dispelled the blissful dreams of that class of 'tramp' labor from which the ranks of the I. W. W. mostly have been recruited. The great mass of American labor has nothing in common with those pariahs of the industrial world. Now another blow has been struck at the same shiftless sowers of dissension. The 'tramp' worker is only a degree above the hobo; they are varieties of the same species, and are for sale to any dealer in iniquity. Thus, the revelations at Chicago have shown how the I. W. W. were used as an instrument of the most corrupt propaganda ever known to man—the propaganda of German kultur. The 'tramp' disguised as a workman has worn the 'grouch' as his most conspicuous garment; he has disturbed the peace of honest men who labor with their hands to provide homes and loving care for wives and children. It is he, more than any other, that has fought against the right of employers to discharge men from service except under narrow rules established by the labor-unions, while at the same time insisting upon the privilege of asking for his 'time' whenever it might suit his whim, regardless of the gap his sudden departure might create in the ranks of the miners, the millmen, or the factory-hands. The President has now created a war-labor board, and after August 1 the employment and distribution of certain classes of workmen will come under Federal direction. In the view of the Government, the skilled laborer is rightly regarded as a man of responsibility, worthy to be trusted in choosing the best place to use his ability, for the brain receives culture

from the training of the hand; so the new order, by applying only to the unskilled, strikes directly at the root of much of the difficulty that has disturbed the industrial world since the War began. On the acceptance of a working plan for the better stabilization of labor the employer and employee can be drawn into closer sympathy as true coadjutors, and this makes for an economic and spiritual uplift. The two are more nearly related than the world generally has realized.

LET us hope that the maximum punishment enforceable by law will be meted to the Western Union Telegraph Company for its cynical effrontery, as disclosed by the arrest of the men that were caught carrying bundles of telegrams on the trains between New York, Boston, Philadelphia, and Washington. The punishment should fall upon the highest officials cognizant of, and therefore participating in, the offense. The incident comes home to all of us. It is a mean kind of stealing by a public utility corporation operating under special privileges granted on the supposition that it would serve the public honestly. The excuse that owing to the rush of messages the company found it impossible to transmit them by wire is only an added impertinence. If that were so, why did they charge the full rate, instead of charging a cost equal to that of immediate-delivery postage? The excuse is all the more impudent because we in San Francisco remember how at the time of the earthquake-fire the Western Union accepted thousands of telegrams and cablegrams that the company did not transmit by wire, but either threw into the waste-paper basket or forwarded by mail, at a cost of two cents per message as against the dollar or more that it placed in its cash-box. It is a stain on our local press that this flagrant larceny was not exposed relentlessly at that time and that the Western Union was not then deprived of its franchise. Such acts are demoralizing in the extreme to our whole system of public utilities and unless they are punished promptly they create prejudices highly detrimental to the national welfare.

IN this issue we publish the testimony given by Mr. Van. H. Manning, Director of the U. S. Bureau of Mines, before the Committee on Mines and Mining of the House of Representatives on the War Minerals Bill. The position held by Mr. Manning and the confidence of the public in his statements on the subject are such as to make his testimony particularly interesting. After all, the justification—the ample justification—for our national mining industry at this time lies in the immediate and invaluable assistance that it is giving the Government in waging this great war. Mining is essential as never before, and everything that it is doing for the national cause is of the most timely interest. Therefore we need not apologize for giving so much space to Mr. Manning's testimony. Among others invited to attend and testify were Messrs. George Otis Smith, Director of the U. S. Geological Survey; Bernard M. Baruch, chairman of the War Industries Board; William H. Nichols, of the General Chemical Company; C. K. Leith, chairman of the Committee on Mineral Imports; Bradley Stoughton, secretary of the A. I. M. E.; William Young Westervelt, chairman of the War Minerals Committee; Walter Douglas, president of the American Mining Congress; Joseph W. Richards, chairman of the Iron and Steel Committee; Walter R. Ingalls, editor of the 'Engineering & Mining Journal'; Herbert C. Hoover, Food Administrator; Philip N. Moore, ex-president of the A. I. M. E.; J. F. Callbreath, secretary of the American Mining Congress; F. W. De Wolf, president of the Association of American State Geologists; H. A. Buehler, State Geologist of Missouri; W. O. Hotchkiss, State Geologist of Wisconsin; Harry L. Day, mine-operator in Idaho; D. G. Kerr, vice-president of the U. S. Steel Corporation; Pope Yeatman, of the War Industries Board; and Cornelius F. Kelley, vice-president of the Anaconda Copper Company. In our next issue we shall publish the testimony of Mr. Ingalls, who spoke in opposition to the Bill.

Leasing Mineral Deposits on Indian Lands

The Senate has passed bill No. 385, introduced by Mr. Henry F. Ashurst, of Arizona, throwing open practically all the Indian reservations in the country to prospecting for minerals, and authorizing the location of metalliferous deposits in the same manner as that prescribed under the mining law of 1872. This is similar to a bill passed by the House of Representatives in the last Congress. The Senate bill accordingly may be expected to receive prompt approval by the House, especially as it is a war measure. The chief avowed object is to render available certain large deposits of manganese said to exist on some of the reservations, but it must not be overlooked that the miners of the West have cast jealous eyes upon the Indian lands for many years. Senator Ashurst admitted that many would fear that the bill was merely the poking of "the camel's nose under the tent, and that the animal would get in completely later on." That is what the friends of the Indian are sure to think, and their suspicions are not without justification. Section No. 4 of the bill concedes the right of a locator to obtain from the Secretary of the Interior the privilege "to use during the life of the lease a tract of unoccupied land, not exceeding 80 acres in area, for camp-sites, milling, smelting, and refining works, and for other purposes connected with and necessary to the proper development and use of the deposits." Since no persistence in mining or production, beyond that involved in doing $100 worth of work per annum on each claim, is required, the way appears easy for certain classes of settlers to effect a permanent occupation. In this respect the rights of the Indians would seem to have been imperfectly safeguarded. Locations are to be made in the manner customary for the acquisition of claims on the public domain, but within a year after posting a location notice the claimant must apply to the Depart-

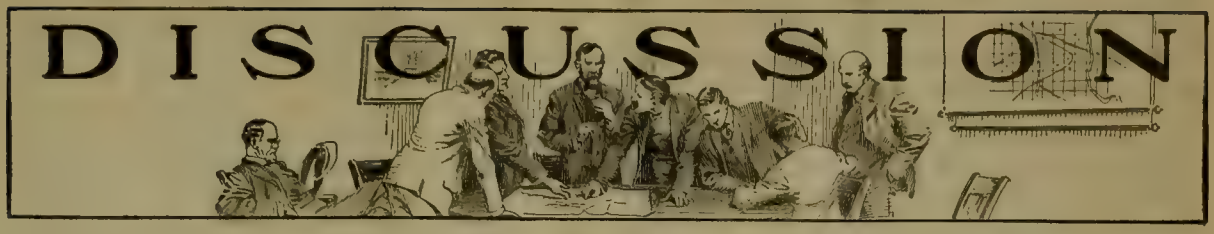
ment of the Interior for a lease, and thereafter the lessee must pay to the United States, for the benefit of the Indians, in consideration of "the privilege of mining or extracting the mineral deposits, a royalty of not less than 5% of the net value of the output," and an annual rental "of 25 cents per acre for the first calendar year thereafter, 50 cents per acre for the second, third, fourth, and fifth years, respectively, and $1 per acre" for each succeeding year. The leases are to run for a period of 30 years, with the right of renewal for successive periods of 10 years. Here again an invasion of the rights of the Indians might be possible. Their only recompense would be derived from the royalties paid, and the language of the bill would seem to bear the interpretation that payment shall be made only after the issuance of the lease, while the "mining claims may be located by such citizens (of the United States) in the same manner as mining claims are located under the laws of the United States." The Secretary of the Interior receives no authority to impose regulations applicable prior to the issuance of a lease, from which it will be argued that holders of claims may exploit them for one year free from any restrictions and solely for their own benefit. This is not in conformity with the expressed purpose of the sponsors of the measure, but on the other hand it is evident that the necessity for securing leases immediately after location would have delayed the production of manganese and other minerals for use in making war-material. It would have been easy to have exacted an accounting for minerals shipped prior to the execution of a lease, but no such obligation is written in the bill. Anxiety was shown by numerous senators to play fair with the Indians, and a reluctant consent to the measure was obtained from them on the plea of high emergency, despite some risk of invading the rights conceded to the Nation's wards. Senators Shafroth and Smoot objected to the introduction of the leasing system, when applied to metalliferous deposits, as being wrong in principle, and the bill would have been strenuously resisted on this ground except for the assurance that it was not intended to establish a precedent, and that no other convenient means could be found for remunerating the actual owners of the land.

The bill as originally drawn provided for the payment of a royalty of 5% on the gross value of the ore. That would have proved so heavy a burden that the opportunity afforded for mining on Indian lands would have been limited practically to small rich deposits, such as might be exhausted quickly under the stimulus of exorbitant war-prices. The change to 'net value' indicates that the object is not merely to serve the needs arising from the present conflict but to open the metallic resources of these lands to final and complete development. This means nothing less than the encroachment of modern industry upon the preserves of the aborigines, the growth of towns, the development of water on a scale adequate for mills and smelters and crowding workmen. Under pressure of the wants of large industrial communities, more and more concessions will be demanded and are sure to be granted. This is the logical result of expansion into undeveloped territory. The rights of those that fail to employ the land productively have always been brushed aside in the march of progress. Sanction for our occupation of the whole continent rests upon that principle; nevertheless it is with regret that we see this harsh political philosophy applied to the petty remnant of the Indian lands at a time when the minds of our people are filled with idealistic social doctrines, preached from the White House, the pulpit, and the platform. It might be well to regard more reverently and more consistently the treaties we had signed with the Indians. Though we shrink from too wide an extension of government ownership, it might have been appropriate to have provided that these particular resources of manganese and platinum, so forcibly cited as an argument for shoving the bill through the Senate, should be developed under the direct control and management of a Government bureau for the pecuniary benefit of the actual owners in law and equity.

The Slump in Gold

In the annual report of the Dome Mines Ltd., in Canada, the manager, Mr. Charles D. Kaeding, refers to the cessation of productive operations and says: "The economic fallacy of operating a gold mine under existing conditions, even were there a sufficient supply of labor, is now so much better understood that it is hardly necessary to point out the decreasing profit per ounce of metal due to the increasing cost of production and the fixed price of this standard. It will not be possible to resume operations until conditions become more favorable." This company closed its mill in December last and is now restricting work to the sinking of its main shaft. Another company, the Canadian Consolidated Mining & Smelting Company, has issued a notice to its employees in British Columbia, stating: "Large increases in the various items entering into the mining and smelting of the Rossland ores, such as wages, cost of explosives, coke, steel, general mine and smelter supplies, without adequate compensation in values by way of increased metal prices, coupled with increased taxation, have made it necessary for the company to suspend shipments from the Rossland mines indefinitely. An endeavor will be made to keep a small force on development work, and to place the remainder of our Rossland employees at the smelter, the Sullivan mine, Kimberley, and other lead-silver properties of the company." The ore produced by the mines at Rossland is a low-grade silicious copper ore valuable chiefly for its gold content. One of the company's officials says: "As a gold dollar will hardly buy half as much as before the War, there appears to be no great advantage in mining gold ores at this time—especially when almost every variety of mining cost has doubled and more." These remarks will find a sympathetic response among gold miners elsewhere. In California it is reported that the shortage of power may compel dis-

crimination in the distribution of electrical energy, and that one of the first industries to suffer will be gold mining on the Mother Lode, on the supposition that it is not among the activities most essential to warfare. We say 'supposition', advisedly, for to us it seems a fallacy to suppose that gold is not an important resource in time of war. "We don't want gold from the mines; we can make money with a printing-press," says the shallow observer, echoing a sentiment that is allowed to grow like an economic weed. Assuredly if the gold miner is to pay a double-price for his material and is to receive a half-price for his product, he will be well advised to cease production until such time as gold is in demand again; and that time is sure to come on the day of reckoning when the paper-credits now so freely issued are brought to account. The terrific slump in the commodity-value of gold is perhaps our best example of the evil effect produced by discriminatory price-fixing. In terms of drill-steel, looking at the matter from the vendor's end, 286 pounds of ⅞-inch octagonal steel would buy a shining double eagle in 1912, whereas only 80 pounds are needed now to land the same sum in the steel merchant's bank account. In this case the decrease in the commodity-value of gold has been 72%, or, to state it in terms of steel, the price has risen 257.5%. Compared with copper, the average price of which for many years before the War was 15 cents per pound, 133⅓ pounds would purchase a $20 gold-piece in 1912, while 85 1/10 pounds will capture it today, the corresponding percentages being 36.1 and 56.6. It will be observed that we have compared a finished product with a refined raw product. The quotations on drill-steel, however, are based upon the ingot, the price of which is fixed, while no control is exerted over the manufactured article. The price-ratio between steel ingots in 1912 and at the present time is 2.72, representing a decrease in the purchasing power of gold amounting to 63.3%, much more nearly approximating the relations shown by the prices paid for copper in the two periods. Tungsten is a conspicuous example of the opportunity presented by an uncontrolled industry to advance prices to an abnormal height. Before the War the average quotation was about $6.50 per unit of WO_3; the current quotation is $24. Using our reversed view of the relation of commodities to money, 3.076 units, or 61.52 pounds, would buy $20 in 1912, whereas 0.833 unit, or 16.66 pounds will do it today, the purchasing power for gold having augmented 269.2%. Examples might be multiplied to illustrate the truth that price-fixation, when not based on a strictly democratic principle, exposes the restricted industries to extortion by those that are free. Gold has suddenly become altered in its relation to commerce; suddenly it finds itself among the fettered. Formerly it was the arbiter of value. Quantity of merchandise was expressed in terms of a unit-weight of this token-metal. Being the unit of reference it must be considered, for monetary purposes, as having no value in itself. The common fallacy of a superabundant intrinsic value in gold as the thing that determines its use as a monetary standard grew out of failure to note the fact that it was just because gold was so lacking in adaptability to utilitarian purposes, while at the same time possessed of extreme beauty, density, and resistance to corrosion, that it fulfilled so perfectly the requirements of a token in commodity-exchange. Such a token by its very nature must come as near to typifying an abstract conception of measure as any material thing can do. The yard-stick that measures cotton cloth cannot safely be a piece of cotton cloth, but rather an expanded unit derived from the fundamental conception of the human energy required to produce the three barley-corns that made the inch of our grandsires. The human effort represented in the pleasing and nearly indestructible gold is at the bottom of the idea of the standard for which men will exchange the fruit of their labor. It is human-power, 'man-power' in the phrase of the day, that we exchange with each other, and the gold is the symbol of it, as the cross is the symbol of redemption. What would you do with the gold you receive but exchange it for something else? Would you make yourself a hoe of it, or a sword, or an automobile? Steel would be worth vastly more for any of those purposes. So, while the world crowded the busy marts, buying and selling, as there was need, and doing it in the name of the imperishable and gleaming symbol of labor, gold was the prince over industry. The moment, however, when men no longer may appraise their wares in barter on the sole basis of need, but discover the offspring of some labor bound and that of other labor free, the prince of trade himself, in whose name a value has thus been quoted falsely, becomes a slave among the bondsmen, and is delivered over to the scant mercy of the industries that have not been chained. Moreover, because value is still expressed in terms of gold, you cannot fix its own value at a higher level, for if you do the credits piled to such a dizzy height in representation of services rendered in the past, gauged as they are by this golden measure, will at a single stroke have been blotted from the account to the extent that the arbitrary weight of gold in the dollar may be changed. The basis of industrial confidence would be so shaken by it that the world would experience the calamity of a plunge into commercial and industrial chaos. There is but one way to protect both gold and general industry; and that is to build up the gold reserve faster and faster as a foundation adequate to sustain the growing national indebtedness. That indebtedness means services loaned, but the repayment must be made in currency, the only guarantor of which is the royal metal. The way to re-enthrone gold as the arbiter of commercial value is either by crystallizing the prices for all commodities, or by letting all markets regulate themselves on the ancient principle of supply and demand. Half-slave and half-free it is certain that industry, commerce, banking, and insurance, will presently fall into a slough of difficulties from which we may not extricate them before appalling damage will have been inflicted not alone upon the economic life of our own day but upon that of generations to come.



Magazines for the Wounded

The Editor:

Sir—The American Committee of Engineers in London has received a request for copies of American Technical magazines for the use of American hospitals in England, France, and other European countries where such are established. Although many London offices receive regularly the American mining, electrical, railway, mechanical, excavating, and other technical periodicals, there is no regular system of distribution by which such publications can reach wounded officers and soldiers of the American Army. We therefore beg that you will publish this letter in your columns, together with the request that any individuals or companies having spare copies not needed for their files will forward the same either directly, or through the medium of the local Red Cross, to Mrs. Miller, American Red Cross Care Committee, 154 New Bond St., London, W.

C. W. Purington.

Manganese

The Editor:

Sir—The recent fixing of prices on manganese ore by agreement between the American Iron & Steel Institute and the War Industries Board is unfair to Californian producers and will result in a lowering of returns to ore-producers in northern California, and will undoubtedly curtail if not wholly eleminate production. Proposed additional freight-rates are prohibitive.

Prices are now based on deliveries at South Chicago, the freight paid being deducted from returns to the ore-producer. Freights from Pacific Coast points to South Chicago are from 50 to 100% higher than from other producing points. A bonus is given to producers east of Chicago, although their freights are much lower than ours. No reason is announced for this bonus. If any bonus is paid to any producer, surely those paying highest freight-rates are entitled to it.

Smelters on the Pacific Coast, by buying on the Chicago base, will obtain their ores at a lower price than previously prevailing prices. When 80% ferro-manganese was selling at $250 per ton, we were able to dispose of all our ores at from 16 to 25% higher than we will receive under the fixed prices and now the ferro-manufacturers have had their returns increased by the lowering of the specifications to 70% manganese content with no lowering of the price per ton.

Our ores are nearly all high in silica, low in iron, and low in phosphorus. Although in the past we have sold our ores on the basis of total free silica and free silica to 20% and the manufacturer has been glad to get them, we are now being penalized on the silica and no allowance made for low iron and low phosphorus. We are paying the highest mining wages in the country in this industry and this is necessary as the mines are new and do not possess the comforts found in the larger mining camps.

So far as we know no producers in Northern California were asked to submit any figures showing what the price-fixings would do to his ores. The present output is not large, but, if encouraged, production might become important factor in the national supply.

M. C. Seagrave.

San Francisco, June 17.

Locating Metalliferous Lodes Containing Alunite

The Editor:

Sir—I am writing you for information, and will be thankful if you will answer the following question. I have had the matter up with several persons, and have had a different answer from each of them. A number of us have located mining ground containing gold, silver, sulphur, cinnabar, and alunite. The properties are held in part as a quartz and in part as a placer location. We have performed the location work and have had the claims recorded. The claims were located and the location-work was done in January 1918. The ground containing the silver veins also contains large bodies of alunite and cinnabar. We recently tried to dispose of our holding, and were informed we would have to lease it from the Government, while others affirmed that we could hold it as a quartz claim. We would like to know what we have to do to hold our claims, and to obtain a valid right that can be conveyed. We would also like to know if it is true that the Government has passed a law making it necessary for one to lease ground containing alunite.

J. F. Law.

Salt Lake City, May 26.

[The mining law of 1872 still holds good as to all minerals not otherwise provided for according to recent acts of Congress. Under its terms a valid lode-claim can be located on any unappropriated public land of the United States, wherever a valuable deposit of gold, silver, cinnabar, or other minerals not excepted by special legislation can be shown to exist. The incidental accompaniment of alunite cannot defeat the right of a discoverer to locate a deposit of gold or silver or other metals when

the quantity present is sufficient to admit of their economic exploitation. We are advised by legal authority that in view of the recent legislation by Congress, applicable to chlorides, sulphates, carbonates, borates, silicates, or nitrates of potassium (Public No. 49, 65th Congress, approved October 2, 1917) a locator of lands containing gold, silver, or other metals, would not, in all probability, acquire the right to mine and dispose of deposits of alunite found in the same located lands. Section 12 of the act above referred to contains the following language: "That the deposits herein referred to, in lands valuable for such minerals, shall be subject to disposition only in the form and manner provided in this Act, except as to valid claims existent at date of the passage of this Act, and thereafter maintained in compliance with the laws under which initiated, which claims may be perfected under such laws." While the Act has not as yet, to our knowledge, been construed by the courts, it seems to be intended to provide specifically for the exploration of lands valuable for potassium deposits, and for the disposition of such deposits. It is to be noted that the Act repeatedly refers to the deposits of potassium rather than to the lands containing them, and it is reasonable to assume that such deposits wherever found in lands not lawfully claimed at the date of the Act, October 2, 1917, become permanently seegregated from the Public Domain, at any rate, where known to exist. Of course, if patent should issue for the mining claims containing gold, silver, or other metals, and deposits of potassium salts should be discovered subsequently, they would most probably be held to be the property of the owner of the patent title.—EDITOR.]

Formulas for Mine-Valuation

The Editor:

Sir—In your issue of May 18 appears an article on this subject by W. W. Whitton, in which the author undertakes to show that the old Hoskold formula for calculating the present value of an annuity yielding interest to the investor at one rate, and redeeming the invested capital by means of a sinking-fund earning a lower rate, is in error by as much as 20% when applied to the valuation of a wasting asset such as a mine. The same arguments against the old formula have been brought up from time to time; the first time I remember hearing them was in South Africa in 1904.

The question as to whether the Hoskold method of mine-valuation is in error or not depends upon the definition of 'a 10%' or 'a 6%' or any other rate of investment, for a finite term of years. A 10% investment for a definite period is commonly understood to mean one that will pay the investor 10% interest per annum on the capital invested and return the total amount of the capital at the end of the period. A 7% twenty-year bond, for example, is one that will yield 7% per annum on the par value of the bond, and return the par value at the end of 20 years. The sinking-fund to redeem the bonds is usually provided by the company out of the profits of the business.

Let us consider Mr. Whitton's case of a mine with an expected life of 10 years, paying an annual dividend of $1000, the rate allowed on the investment to be 10% and on the sinking-fund to be 4% per annum. By the old Hoskold formula the present value of this annual dividend is $5455.81. Out of each year's dividend $545.58, or 10% on the investment, is paid as interest and $454.42 is put into the sinking-fund. At the end of the ten-year period the investor will have received 10% per annum on his investment and his capital back, which fulfills the definition of a 10% investment.

According to Mr. Whitton's proposed method of valuation, the same mine would have a present value of $6591.37, and the annual dividend would be distributed as shown in the following table:

Year	C	d	Ci	d-Ci	Amount in sinking fund
1	$6591.37	$1000	$659.14	$340.86	$340.86
2	6250.51	1000	625.05	374.95	729.44
3	5861.93	1000	586.19	413.81	1172.42
4	5418.94	1000	541.89	458.11	1677.43
5	4913.93	1000	491.39	508.61	2253.13
6	4338.22	1000	433.82	566.18	2909.44
7	3681.91	1000	368.19	631.81	3657.62
8	2933.72	1000	293.37	706.63	4510.56
9	2080.78	1000	208.08	791.92	5482.90
10	1108.44	1000	110.84	889.16	6591.37
			$4317.96		

The column 'C' shows the amount of capital remaining invested at the beginning of each year, column 'd' the annual dividend, column 'Ci' the interest paid to the investor, and column 'd-Ci' the amount put into the sinking-fund. The last column gives the total amount in the sinking-fund at the end of each year.

It is immaterial in this discussion whether the mining company or the investor looks after the sinking-fund. It cannot be used for any other purpose than to redeem the capital invested, and therefore cannot be considered free capital to be used for other purposes until the end of the life of the mine. At the end of the life of the mine the investor in this case will have received $4317.96 in interest and his capital back, or an average of 6.5% per annum.

An investor in mining stocks takes more than the ordinary risk because of the larger return on his money if the mine comes up to expectations. He assumes this risk at the moment of purchasing the shares, before it is certain that the mine will come up to expectations. Would he assume the risk if he knew that, in the event of the mine's fulfilling all expectations, he would only receive a rate of interest which could be had by investing in something much more secure, for instance bonds? He would certainly buy the bonds and avoid the risk.

According to the definition of a 10% investment given above the old method of valuation is not in error.

New York, June 8. K. F. HOFFMANN.

TAILING dressed by flotation at the Broken Hill Proprietary Co.'s works in New South Wales totaled 3,291,942 tons to the end of November 1917. This yielded 816,734 tons of concentrate. The slime-flotation plant (Bradford process) is making a concentrate carrying 48.79% zinc, 4.81% lead, and 14.80 oz. silver; and 61.62% lead, 8.98% zinc, and 83.25 oz. silver per ton.

The War-Minerals Bill

EVIDENCE OF VAN H. MANNING, DIRECTOR U. S. BUREAU OF MINES

The Committee on Mines and Mining of the House of Representatives, under the chairmanship of Mr. Martin D. Foster, of Illinois, has held a series of meetings during the last three months in order to elicit an expression of opinion from representative men concerning the bill "providing," as the Chairman said, "for the national defence by encouraging the production and conserving the supply of metals and minerals for the needs of the Government." Among those invited to testify was Mr. Van H. Manning, Director of the U. S. Bureau of Mines. His testimony was fortified by a mass of valuable information, which we publish herewith, together with the colloquy between him and members of the Committee.

MR. MANNING: I would like to make a short statement in regard to the importation and uses of minerals of military importance. The Interior Department has prepared an extensive statement on the subject. I think it would be interesting reading to the members of the Committee, and also the House when they have the bill under consideration, and, with your permission, I would like to submit it for the record. [Here follows Exhibit A.]

IMPORTANCE OF MINERALS TO WARFARE

Minerals furnish the most important materials for munitions. The importance of the following minerals is far greater than either their tonnage or value would indicate. The two fundamental materials for the production of all modern high-power explosives are nitrate, chiefly as nitric acid, and concentrated sulphuric acid made from pyrite or sulphur. Manganese is the most essential alloy for high-grade steel for munitions and important industrial uses. Flake graphite is used for crucibles required in the production of brass and crucible steel. Tin is required for tinplate for utensils and cans for preserving food and for bearing-metal. Mercury is used as fulminate to explode cartridges and shells, and is essential for the safe and effective use of all high explosives. Potash is used chiefly for fertilizers with small amounts for explosives, soap, glass, and chemicals. Tungsten is an essential alloy for high-speed tool steel. Antimony is required for hardening lead for bullets. Chromite is used to make an alloy for tool steel and as a refractory lining in basic open-hearth steel furnaces. Magnesite is used as a refractory in metallurgical plants. Mica is indispensable as an insulating material in the manufacture of electric apparatus.

DANGER OF DEPENDENCE ON FOREIGN MATERIALS

Many of the minerals referred to in the bill have been largely imported. Dependence upon foreign sources for mineral supplies may involve the diversion from military service of ship tonnage for the actual import of the minerals themselves; for the movement of fuel, equipment, and supplies to the foreign mines producing these minerals, for the possible transportation of other products which the nations upon whom we depend may exact from us in return for their essential minerals. In view of the uncertainty of such supply, as well as the shipping involved, it is essential that domestic production be stimulated to the utmost.

RELEASE OF SHIPS FOR MILITARY PURPOSE

At the present time every ship that can be spared is needed to extend our military operations. The minerals imported come from many distant sources involving long voyages and delays in loading. The minerals mentioned represent an import of about 2,000,000 long tons per year, three-fourths of which at least can be eliminated in case of extreme necessity. Every additional day spent in the submarine zone is dangerous. In addition to the sacrifice of ships the importation of bulky minerals congests our ports and exhausts our credit in the purchase of supplies abroad.

IMPORTANCE OF STIMULATING DOMESTIC PRODUCTION

We have increased our production very slowly, due to many factors which can and must be remedied. Uncertainty as to the length of the war, fear that sudden return of peace will close down the new mines, no effective guarantee of prices for a reasonable time, and difficulty as to securing labor, fuel, and supplies have discouraged the producer.

The consumer has not realized that new production is usually a matter of at least six months' time; he has depended upon the Government to take care of his needs; he has hesitated to use new materials; his efforts have been largely bent toward urging the necessity of import without realizing the seriousness of the shipping situation.

If this country is to be assured of an adequate supply of minerals for any possible contingency of war, constructive stimulation of production must be undertaken without delay. This should include not only imported minerals which we can largely produce at home, but in addition those minerals which we now produce at home but whose production may have to be increased as our military requirements expand.

IMPORTANT USES AND SUPPLY OF SPECIAL MINERALS

ANTIMONY is used as an alloy of lead to harden bullets for small arms and shrapnel, as an alloy, in type metal for printing, and in bearing-metals used to lessen friction. About 23,000 long tons of metal were required in 1917. Over 21,000 tons were imported, two-thirds of which came from China and the rest from Bolivia and Mexico. The principal domestic sources of ore contain-

ing antimony are in Nevada, California, Idaho, Washington, and Alaska.

Arsenic. The most important uses of arsenic are for insecticides and weed-killing compounds, disinfecting, vermin poison, and in glass making. The 1917 requirement was about 10,000 short tons, 40% of which was imported from Mexico and Canada. The United States production comes almost entirely as a by-product from smelters.

Ball Clay—Kaolin—Paper Clay. Ball clay is a white-burning clay used by potters to give plasticity to their mixtures. Kaolin is a white-burning clay employed chiefly in the manufacture of white earthenware and porcelain. Paper clay is any fine-grain clay of proper color that can be used as a filler in the manufacture of paper. Kaolin is the clay most commonly used for this purpose. Kaolin and ball clay are required in the manufacture of the better grades of pottery, sanitary ware, tiles, and porcelain for electric insulation. In 1917 about 260,000 long tons of these clays were imported, chiefly from England. If the import of these clays is discontinued, due to the scarcity of shipping, steps must be taken to further stimulate the production of properly prepared grades of domestic clays. Deposits of ball-clay are found in Kentucky, Tennessee, Missouri, Florida, and New Jersey; of kaolin in North Carolina, Pennsylvania, Alabama, Georgia, South Carolina, Connecticut, Maryland, and Virginia.

Bismuth. The various salts of bismuth are largely used in medicine, particularly for the dressing of wounds, and a small amount is used in type metal. The total amount used is small. Under normal conditions about 100 short tons was imported, but this import has greatly declined since the War. The chief source of domestic supply is from the electrolytic refining of lead bullion and flue dust.

Bromine is important because of its uses in medicine, chemicals, and war gases. The total quantity used is relatively small. The United States production in 1917 was 450 tons. It is produced in connection with the manufacture of salt from natural brines from Michigan, Ohio, and West Virginia.

Cerium. Salts of cerium are used in the manufacture of aniline black, in a number of inorganic compounds, in photography, and in medicine to a small extent. Its use has been suggested for the ignition of explosives and as an illuminant in military signaling. Cerium is contained in the residues obtained from monazite in the extraction of thorium. No figures of production have been compiled, but in the past the available supply has greatly exceeded consumption.

Chalk. A great deal of crude chalk has been formerly imported from Europe due to cheap ballast-rates. In 1917, 130,000 long tons were so imported. It is largely used in the manufacture of whiting which is used as the basis of white-wash, to mix with other pigments, and for putty. In case the shipping situation makes necessary the discontinuance of this import, steps must be taken to secure suitable domestic material or substitutes to replace it.

Chromite is used as the alloy ferro-chromium in the manufacture of special steels for high-speed tools, of automobile axles and springs, locomotive frames and springs, certain parts of ore-crushing apparatus, in projectiles, armor plate, and cannon linings. It is also used as a refractory lining for metallurgical furnaces, and its various salts are used in special leather-tanning processes and for chemical colors and dyes. In 1917 the domestic production is estimated at about 42,000 long tons and the import at 72,000 long tons, making a total supply of 114,000 long tons, which is a falling off of about 50,000 tons as compared with 1916. The import comes principally from Rhodesia and New Caledonia. The domestic production has come principally from California and Oregon.

Cobalt is used as an alloy in the manufacture of high-speed tool steels and also used in coloring glass and ceramic wares. A new alloy called stellite, consisting of chromium and cobalt, possesses properties which make it a most desirable tool steel. The increased demand for cobalt may probably be traced to this alloy. The United States production of cobalt in the past has been negligible. One or more deposits containing cobalt are now in course of development. The principal source of supply is Canada, and imports of cobalt and cobalt ores in 1917 amounted to 100 long tons. The most important domestic deposits are in Missouri and Idaho.

Corundum and Emery are the two most important natural abrasives which have been imported. They are necessary for the grinding of optical glass and special grades of steel for munitions. The best grade of imported emery comes from Greece (Naxos) and corundum from India and Canada. New York is the principal source of domestic emery and North Carolina of corundum. The production in 1917 was 16,000 short tons and the imports about 2000 tons.

Ferro-silicon is an alloy of iron and silicon which is made in the electric furnace. It is used to deoxidize steel and in the manufacture of non-corrosive cast-iron used in chemical plants, particularly those which made acids.

Fluorspar. The principal use of fluorspar is as a flux in the manufacture of open-hearth steel. In addition, it is used in the metallurgy of aluminum, copper, antimony, and lead, and in the manufacture of hydrofluoric acid. The United States production has increased since the War to 156,000 short tons in 1916, while the import from England has dropped off to about 10,000 tons. The United States production comes principally from Illinois and Kentucky.

Fuller's Earth finds its chief use in the bleaching, clarifying, or filtering of fats, greases, and oils, particularly in the refining of petroleum. The United States production has increased largely since the War to 68,000 short tons in 1916, while the import has decreased somewhat to about 15,000 tons. Three-fourths of the domestic production comes from Florida, with Georgia as the second State in importance.

Graphite is an important war material because of its use in the manufacture of crucibles required in the pro-

duction of brass, bronze, crucible steel, and various other alloys and metals. Only the flake form is used for this purpose. The amorphous form is less important and is used for foundry facings, paint, lubricants, and lead pencils. In 1917 the domestic production was approximately 3400 tons of flake graphite and the foreign import about 27,500 tons, making a total supply of about 31,000 tons. The import comes chiefly from Ceylon and Madagascar, the domestic production from Alabama, Pennsylvania, and New York.

Grinding Pebbles. Flint pebbles imported from Europe are used for grinding cement clinker, ores, minerals, etc., and are also themselves ground for use in pottery. Imported pebbles are generally superior to the domestic grade, but since the beginning of the War domestic material has been more widely used. The domestic production in 1917 was 19,000 tons, and imports amounted to approximately 10,000 tons. The domestic output, largely in the form of natural beach pebbles, comes from California.

Iridium is a metal closely associated with platinum and is used as an alloy to harden platinum for use in contact points for magnetos. The quantity used is very small, but is absolutely essential. Shortage of this metal would be even more serious than a shortage of platinum.

Magnesite when calcined at high temperature produces a very dense fire resistant and chemically inactive substance. Its use is chiefly for refractory bricks, as linings for open-hearth steel furnaces, copper converters, reverberatories, electric, and other furnaces. In 1913, 185,000 short tons of magnesite were imported, chiefly from Austria and a small domestic production came from California. New deposits were discovered in the State of Washington, and at the present time the product from California and Washington meets our requirements.

Manganese is used as an alloy in the manufacture of the greater portion of our high-grade steel. A very small quantity is used in dry batteries, glass manufacture, and dyes. Manganese is the best-known material to produce a dense homogeneous steel free from honey-combing and blow-holes. It is generally added in the form of an alloy of manganese and iron, the high-grade material being known as ferro-manganese and the low-grade material as spiegeleisen. At the present time, steel industry requirements are from 700,000 to 800,000 long tons per year of high-grade ore, besides a large quantity of lower grade ores. In 1917 over 500,000 tons were imported from Brazil, 50,000 tons from India, and about 60,000 tons from the West Indies, and Central America. The domestic production of high-grade ore was 114,000 tons. The principal producing districts for high-grade ore are Montana, Arizona, California, Arkansas, Virginia, Georgia, Utah, and Tennessee. Large quantities of low-grade ore come from Minnesota, Colorado, New Mexico, and New Jersey. There are many small scattered deposits and the possibilities for large increase in production is very good.

Mercury. The most important use for mercury is in the manufacture of fulminate for use in caps to explode shells, cartridges, blasting charges, and mines. It is thus essential for the safe and effective use of high explosives for both war and peace purposes. Other uses are in paint to prevent the fouling of ships' bottoms, in the amalgamation process for the recovery of gold and silver, in drugs and for scientific apparatus. The consumption of mercury in the United States is now between 1,750,000 and 2,000,000 pounds. While there has been normally some imported from Spain and Italy, the United States has also exported mercury. The principal mercury producers are California, Texas, and Nevada. The domestic production in 1917 was 36,000 flasks, the imports 5200 flasks, and the exports 11,200 flasks, of 75 pounds each.

Mica. Sheet mica finds its most important use as an insulating material in the manufacture of electrical apparatus such as magnetos, spark plugs, electric-light sockets, etc. It is also used in the condensers of nearly all wireless outfits. The total quantity used is from 1000 to 2000 tons. Imports come chiefly from India and Canada. The domestic production is largely from North Carolina and New Hampshire.

Molybdenum is used as an alloy of steel in the manufacture of high-speed tools, and for automobile parts. It serves many of the same purposes as tungsten and is used abroad more extensively than in this country. The total world output is only a few hundred tons, the United States being the largest producer with about 175 tons of molybdenum in 1917. There are numerous deposits in the western United States whose production could be considerably increased.

Osmium is one of the metals associated with platinum. At the present time it is little used, but may become important as a possible substitute for iridium as an alloy to harden platinum.

Palladium is one of the members of the platinum group of metals. Alloys of palladium with gold or silver have recently been devised which furnish a satisfactory substitute for platinum in chemical ware and electric contact and spark apparatus for internal-combustion engines. Palladium is also used for dental purposes. The metal is recovered in the process of electrolytic refining of copper. Deposits containing appreciable quantities of palladium are known in Wyoming and Nevada.

Platinum. The importance of platinum lies in its use as a contact material necessary to promote certain chemical reactions in the manufacture of concentrated sulphuric acid and in the production of nitric acid from ammonia. Platinum is used for utensils in chemical laboratories, for contacts in electric apparatus, for jewelry, and for dental work. For all these uses 120,000 ounces is normally required. The domestic production will supply only a few thousand ounces, coming from California and Oregon. The import has been obtained largely from Russia, with a lesser amount from Colombia. Russia is now a very uncertain source, and Colombia, while increasing, cannot meet the deficiency.

Potash. Before the War we imported over a million tons per year of potash salts from Germany. Over 90% of this material was used for fertilizer, and the remainder was used for various chemicals concerned with the pro-

duction of explosives, soaps, matches, glass, dyes, and tanning. The import has, of course, been entirely cut off, except a small amount from India, and the domestic production in 1917 was only about 12% of normal requirements. A large part of this production has come from old lake deposits in California and Nebraska and as a by-product recovered from cement plants. A great many new processes are being developed for the recovery of potash from alunite, feldspar, marl, and various organic waste materials such as molasses, wood ashes, and wool scourings.

Pyrite is a mineral containing iron and sulphur. It is used chiefly in the manufacture of sulphuric acid. The pyrite when roasted produces a sulphur gas which by various chemical processes finally is manufactured into acid. In 1917 about a million and a half tons of pyrite were available for consumption, one-half of which came from Spain and the remainder from the United States and Canada. A decline in Spanish import has been replaced by an increased domestic production, an increased import from Canada, and a part substitution of sulphur. The principal States producing pyrite are Virginia, California, and New York. New deposits of great promise are being developed in Georgia, Alabama, Missouri, and several other Eastern States. A large amount of this material could be secured as a by-product from coal mines in the Middle West.

Radium finds its most important use in the treatment of abnormal growths and cancers. It has been found beneficial in reducing hard abnormal growths of scar tissue which follow some wounds and has possibilities of being still further used for the healing of wounds. It is finding extended use in luminous paints, for compasses, watches, and other instruments used by aviators and mariners. The United States has the largest supply of radium-bearing ores known, although this supply is very limited. The production in 1916 was between 8 and 10 grammes, chiefly from Colorado ores.

Sea-salt has been used particularly in the preserving of fish, for which purpose it is superior to other salts which are produced in the United States. The import of salt into the United States in 1917 was 66,000 short tons, compared to about twice that amount in 1916. This import was largely sea-salt brought from Mediterranean countries.

Sulphur has several very important uses, particularly for the manufacture of sulphuric acid for munitions and fertilizers, in the production of wood pulp, as a spray for fruit trees, vulcanizing rubber, and for many other essential chemical purposes. Sulphur has furnished material for an enormous expansion in the production of sulphuric acid for munitions. Formerly almost no sulphur was used for this purpose. The United States is at the present time the largest producer of sulphur in the world. The normal production before the War was about 300,000 long tons, which has since increased several fold. A small import has come from Japan. The domestic production is principally from Louisiana and Texas.

Thorium. The nitrate of thorium is used in the manufacture of incandescent gas mantles. Thorium compounds form a portion of some magnesium flash-light powders. Monazite sand furnishes the crude material from which thorium salts have been obtained. The imports of monazite sand in 1916 were 1100 long tons and domestic production amounted to 17 long tons. The total imports in 1917 increased to 2050 long tons. The principal sources of foreign supply are Brazil and India. The principal deposits in this country are in North Carolina, South Carolina, Idaho, and Florida.

Tin is essential in the composition of bronze and for tin plate used in the manufacture of food containers and many utensils. There is practically no production of tin in the United States, although a very small amount comes from Alaska. The United States is importing about 70,000 short tons of tin per year, chiefly from the Straits Settlements and Bolivia. An increased amount of tin ore is being imported from Bolivia for smelting in the United States. In addition to the supply of new tin, a considerable quantity of this metal is recovered from scrap.

Titanium is used in small quantities in cast iron and steel as a purifier, deoxidizer, etc., for increasing the strength and hardness. Salts of titanium are employed as mordants in the dyeing of leather and textiles. The metal may have certain military applications. Titanium is recovered from the minerals rutile and ilmenite. Deposits of rutile are found in any States. Ilmenite is also widely distributed, the most important occurrences being in New York, North Carolina, Texas, and Virginia.

Tungsten is one of the most important alloys for high-speed tool steel, and it is estimated that 99% is so used. Tools made from tungsten steel retain their cutting edge much longer and hold their temper at greater heats and therefore permit much more rapid and continuous operation. Small quantities of tungsten are used in electric-light filaments and in electric contacts. The supply of 60% concentrates is between 8000 and 9000 tons, about half of which is imported and the other half produced in the United States. The larger part of the import comes from South America. The domestic production is chiefly from California and Colorado. Smaller amounts come from other Western States.

Uranium and Vanadium. Vanadium is an important alloy used in tool steel and in cast steel where special toughness is desired, as in locomotive frames and parts of automobiles. The total amount of vanadium used in the United States is only a few thousand tons, largely imported from Peru. The United States has a considerable production from Colorado and Utah. If necessary, much more could be produced from other Western States. Uranium has possibilities for use in tool steel, but thus far it has been little used. The United States has very large deposits in Colorado and Utah.

Zirconium. The chief use of zirconium mineral at present is as a refractory material. Certain alloys have been devised which are said to be particularly suited for armor plates, projectiles, and high-speed machine tools. Among less important uses of its salts are X-ray photography and lighting purposes. During recent years this country has produced no zirconium minerals. The best-



MT. WILSON, IN THE SAN JUAN REGION, COLORADO



JUNEAU, ALASKA. GASTINEAU CHANNEL; ACROSS IS DOUGLAS ISLAND, WITH TREADWELL

known deposits in the United States are in North Carolina and Florida. The principal foreign source is Brazil.

MR. DENISON: Is there anything in this document that ought not to be published?

MR. MANNING: No sir. I think this statement (Exhibit A) will enable the committee to answer any questions that might come up on the floor of the House as to what these minerals are used for and amount imported, and amount of domestic production. I submit another statement (Exhibit B) as to the quantity and value of minerals imported during 1917 aggregating $177,850,000, and the additional value of domestic production $120,000,000, making a total of $297,850,000. The minerals to be controlled are manganese, pyrites, tin, antimony, arsenic, bismuth, bromine, chromium, corundum, emery, graphite, iridium, magnesite, mercury, mica, molybdenum, osmium, platinum, potash, sulphur, tungsten, uranium, and vanadium.

Exhibit B

Quantity and value of certain imported war minerals in 1917

Mineral	Quantity	Value
Manganese, long tons	750,000	$37,500,000
Pyrites, long tons	1,000,000	12,000,000
Graphite, pounds	48,000,000	12,000,000
Tin, short tons	80,000	96,000,000
Antimony, long tons	21,600	9,500,000
Chromite, long tons	72,000	3,600,000
Tungsten, long tons	4,500	6,000,000
Mica		1,250,000
Total value of imports		$177,850,000
Additional value of domestic production		120,000,000
Total		$297,850,000

Note: The above estimates represent only the value of the imported materials. The additional value of the products of the domestic industries of manganese, pyrites, sulphur, sulphuric acid, graphite, tin, mercury, potash, tungsten, antimony, chromite, magnesite, mica, is approximately $120,000,000. Thus making a total mineral value involved of approximately $300,000,000. Sulphuric acid and mercury are not imported to any great extent. Normally over 1,000,000 tons of potash were imported, with a value of over $20,000,000. Since the War this import has been entirely cut off Before the War 170,000 tons of magnesite were imported from Austria with a value of about $2,500,000. This import has entirely stopped.

Only one or two States haven't any of these minerals. Take Indiana, Illinois, and Ohio, for example, they have what are called 'coal-brasses', and the sulphur content of a ton of coal-brasses* is more valuable today than a ton of coal itself.

MR. W. FRANK JAMES: In Michigan what have they?

MR. MANNING: They have bromine.

MR. EDWARD E. DENISON: Dr. Manning, in the mines of Illinois, particularly in certain sections down in the southern part of the State, there are some mines that have always been troubled, as they call it, with a great deal of this hard sulphur stuff that they throw out. Can't that be utilized?

MR. MANNING: That is what the Bureau of Mines started propaganda on several months ago, but the great difficulty was to get the sulphur separated from the coal because of market conditions. They claim they couldn't get the market for the sulphur and therefore they didn't want to separate the sulphur from the coal if they couldn't dispose of it.

MR. DENISON: This will help you find a market for that?

*Iron pyrite.—Editor.

MR. MANNING: No question of it.

MR. MEYER LONDON: Every one of the minerals, I suppose, has a commercial value?

MR. MANNING: Yes, sir.

MR. LONDON: And development of them would be of value to the country years hereafter?

MR. MANNING: Yes.

MR. LONDON: Wouldn't patriotic conferences with the chiefs of the departments largely cure this lack of coordination?

MR. MANNING: We have had such conferences from time to time and I want to go on record in saying that my relations with every branch of the Government service is as cordial as can possibly be. The War Department has given generous co-operation to the Bureau of Mines and has given us large sums for work that they did not have the facilities for doing, realizing we had the nucleus of an organization to build upon. The Bureau of Mines has increased its personnel from 470 men this time last year to about 1700 men now. Of course, these are new departures; the War Department had not undertaken any of this work before. The character of this work is confidential.

I may say, Mr. Chairman, that I haven't found anyone who is opposed to the principles of this bill. I have found opposition among some sources to the inclusion in a bill of this sort of iron, steel, copper, lead, and zinc. This bill, I am sure, you gentlemen are more familiar with than those of us who drew it, because by careful comparison with the Lever bill you will find it almost follows it word for word. We took that bill because we knew the Lever bill had gone through the mills of Congress, and this provides for the mining industry what Congress has done through the Lever bill for the agricultural industry. In my opinion the successful termination of the War depends as much upon the mining industry as it does upon agriculture.

MR. LONDON: These five industries you mentioned—iron, steel, lead, zinc, and copper—are they as essential as these other materials?

MR. MANNING: Yes, sir; I will give you an instance of the Brazil manganese importations. The Brazil imports amount to over 500,000 long tons a year, valued at $25,000,000. The holdings are by the large corporations, and if the Shipping Board takes off a number of vessels from this trade, it means that domestic manganese ore must be substituted to make up the deficit. Under the licensing you gentlemen were inquiring about yesterday, the President would promulgate regulations providing for the distribution of this supply so as to put it in the hands of other manufacturers so that they would be provided with high-grade manganese until it could be obtained from other sources. The Shipping Board will reduce the pyrites imports from Spain this year to the following amounts:

	Long tons		Long tons
April	40,000	August	10,000
May	30,000	September	10,000
June	20,000		
July	15,000	Total	125,000

You must create in this bill a zoning system so as to con-

trol the distribution of these ores in the nearest territory. In the case of pyrites, that may mean the conversion of pyrite-furnaces to burn sulphur. One of the largest sulphur mines we have in the United States is within 3 or 4 miles from the Gulf coast. One shot from a submarine could put it out of business. There are only two sulphur mines in the United States that are producing, and the maximum production is estimated to be about 3500 tons per day. Our estimated requirement of sulphuric acid is between eight and nine million tons a year, and we are producing seven to eight million tons a year, which means that we must find a million more tons of sulphuric acid, which goes into the agricultural and mining industries, into explosives, and into gas which we must have in very large quantities.

THE CHAIRMAN: Is that consumption likely to increase?

MR. MANNING: It will increase.

THE CHAIRMAN: So that we are compelled to develop these necessaries in this country or get them from some other country?

MR. MANNING: Yes, sir.

MR. COURTNEY W. HAMLIN: Has the Bureau of Mines located any other sulphur mines than those you have just mentioned?

MR. MANNING: One just south of Freeport, down near Matagorda, Texas. Recently priority orders have been issued to a company to enable them to get their machinery to their property, which is very promising, and they are on record as saying to me and to the department that they could produce in the course of the next 8 or 10 months, some four or five hundred tons per day. The smelter companies in the United States can produce a very large quantity of sulphuric acid. They don't want to invest several million dollars to put in acid plants to conserve the sulphur going up in smoke at the rate of hundreds and hundreds of tons a day, because there is no price fixed on sulphur or acid, and there is no guarantee given them that if they put their money into it they will get it out. They are perfectly willing to do it under reasonable circumstances.

THE CHAIRMAN: We have the material here if we arrange to utilize it?

MR. MANNING: Yes, sir.

THE CHAIRMAN: What progress is being made in the coke-oven industry?

MR. MANNING: I understand the manufacturers of by-products of coke have contracted for the products of coke-ovens for two or three years in advance.

THE CHAIRMAN: Will they increase the production of these by-products?

MR. MANNING: Yes, sir.

MR. JAMES: Is this bill broad enough to take up every industry that you wish to take care of?

MR. MANNING: Practically. I would like to have seen the entire industry. That is rank heresy before some of these gentlemen here, I guess. As you know, a bill has been introduced by Senator Pomerene to control the iron and steel industries. I feel we should not take too many bites at a cherry, and if you are going to do it you should get them all in.

MR. JAMES: I represent a district composed of coal and iron industries. I don't know how the people feel about it; I don't care; so far as the War is concerned I am willing now to vote for it to take care of the copper and iron industries, or later on, if that matter comes up, I would like to know whether you think we ought to confine ourselves as a war measure to this?

MR. MANNING: It will appeal to the public and Congress that when you build ships you should control everything that will contribute to it.

MR. MAHLON M. GARLAND: Can't you now control iron and steel?

MR. MANNING: That is now being done through the War and Navy Departments for Government purchases. Mr. Baruch of the War Industries Board has called the companies representing this industry together and they have agreed upon a price to the Army and Navy only.

MR. GARLAND: And they can commandeer the entire output?

MR. MANNING: Yes, sir; so I understand. I don't think that is necessary, however, because I think the iron and steel and copper people are just as patriotic a class of people as you find anywhere in the world.

MR. GARLAND: Why exclude them in this bill?

MR. MANNING: Because legislation controlling the iron and steel industries was on the way even before we undertook to frame this bill; representing the Bureau of Mines, I didn't want the iron and steel industries administered without some control over other industries. I didn't think the prices should be fixed without taking into consideration other commodities that are used to produce iron and steel. You can't fix a price on one commodity without taking into consideration everything that goes to make up that commodity.

MR. OTIS WINGO: My attention has been attracted to the wording of the bill, "to assure an adequate supply, equitable distribution, and to facilitate the production and movement of necessaries which in this act shall include ores, minerals, and metals, as follows:" Has your counsel advised you that the language used will limit the terms of this bill to the items named?

MR. MANNING: As the bill is drawn it limits it to minerals specially mentioned in the bill.

MR. WINGO: I know the object of the framers of this bill was to limit the definition of the word 'necessaries' to the particular "necessaries" named in this bill.

MR. MANNING: We wanted it limited to the particular 'necessaries' named in the bill.

MR. WINGO: That is the reason I wanted your viewpoint. There would be no objection on your part to clarifying that language so that the word "necessaries" should be interpreted to mean anything except the words specifically named.

MR. MANNING: Secretary Lane, in reporting on this bill to the chairman, suggested that, beginning on page 2, line 1, after the word "necessaries", it be amended to read as follows:

Which in this act shall include all ores, minerals, and immediate metallurgical products, metals, alloys, and chemical compounds of antimony, arsenic, bismuth, bromine, chromium, corundum, emery, graphite, iridium, manganese, mercury, mica, molybdenum, osmium, platinum, potash, pyrites, sulphur, tin, tungsten, uranium, vanadium, and of other rare or unusual elements the supply of which may, in the judgment of the President, be inadequate for war and industrial needs.

MR. WINGO: But his suggestion in here would still leave the uncertainty that arises in my mind.

MR. MANNING: I see the point.

MR. WINGO: Without committing myself to this particular language, I want to get your viewpoint if it is intended to give you authority to determine what are necessaries?

MR. MANNING: It does not. It is specific phraseology here.

MR. WINGO: We have got men there in Congress as patriotic as you and I, but men who are careful to do things only that are necessary. They would say, "Why not name those things 'necessary' in this act which shall include"—I haven't run it down, but I am afraid from a legal standpoint we haven't named these so as to include ores, and further over here, instead of saying "necessaries named in this act" we say "necessaries". They would say that included potatoes and wheat and rye. As I understand, it is not your desire to get power to do those things, but your desire is to get those necessaries named specifically here, and you wouldn't regard it as antagonistic if that language was made clear, so that the act would include only the items covered by your description here.

MR. MANNING: No objection whatever.

MR. WINGO: You catch the idea I am driving at. Some people might be afraid it would be used to reach out. Especially is that true in the Senate, because one gentleman boasted that the food bill by interpretation, which was contrary to the interpretation the House and Senate and the lawyers put on it, that by reaching out would do things that Congress did not intend should be done. One gentleman made the statement in New York in a speech, which caused a good deal of criticism on the floor of the Senate.

MR. MANNING: I would like to call attention to a letter received by the Secretary of the Interior from the western secretary, Mr. John T. Burns, of the American Mining Congress, which passed certain resolutions. One of the resolutions read as follows:

"Therefore be it resolved, that we favor the encouragement by subsidy, direct and indirect, and in every other way of the production of such rare materials."

And in the preceding paragraph there is mentioned molybdenum and pyrite, etc. Those gentlemen represent mining interests in Nevada, Colorado, Utah, Wyoming, and Montana. We tried to canvass the field to see if there were any serious opposition to this measure, and I found none, except, as I said a while ago, to include all minerals and metals in the operation of this bill.

MR. DENISON: You understand, I presume, under this bill the Government is authorized to take hold of these mines and operate them as Government plants, do you?

MR. MANNING: Mr. Denison, I would rather not answer that question. I would not like to go on record regarding Government ownership, because that is a problem you gentlemen will have to deal with.

MR. DENISON: Do you understand that to be included in this bill?

MR. MANNING: I say that is not contemplated here except in cases of dire necessity.

THE CHAIRMAN: Now, for instance, if a mine should be in litigation and it was essential that the mine should be working for the success of the War, if that mine was closed down and was being kept closed down, the Government ought to have the right to say that that mine must be opened, and if necessary to see that it is opened.

MR. MANNING: That is the point.

MR. JAMES: Suppose a man was not inclined to help the country out of pro-German proclivities, and did not want to operate his mine. Why shouldn't the Government have the right to go in there and operate his mine even if it is Government ownership? Don't you think your bill ought to have that right?

MR. MANNING: Yes, sir.

MR. HAMLIN: We have given the Government that authority in other things to take hold of any factory or anything else needed for the prosecution of this War, and operate them if necessary.

THE CHAIRMAN: That would be only a repetition in this Act.

MR. MANNING: Isn't it true that that only applies to the Secretary of the Navy and the Secretary of War for products for munition purposes? What are you going to do with the domestic consumption?

MR. WINGO: Take the railroad proposition. It authorized the President to take the railroads over and operate them under the Secretary of War and he eliminated the Secretary of War and put it in the hands of the Director General of Railroads. He could name you just like he named McAdoo, is my idea about it, for Army and Navy use only.

MR. MANNING: That is it. For use of the Army and Navy only.

MR. EVERETT SANDERS: Section 12 provides that whenever the President shall find it essential to the successful prosecution of the War to secure an adequate supply of necessaries he is authorized to requisition and take over for use or operation of the Government, and so on.

MR. LONDON: If you read a few lines below you will see he is authorized to take the undeveloped or idle lands or mines.

MR. JAMES: Suppose a man has a mine, he is only working 10% of its capacity because he does not want to help this Government, not very enthusiastic for the War really pro-German, when he was working 10% capacity, and he ought to be working 100% capacity, I don't consider this language adequate because that would not be considered an idle mine, it ought to be broad enough to

take over plants of that kind. Do you figure this language is broad enough? It says "idle" although it might be working 10 or 25%.

MR. MANNING: It ought to be classed as an undeveloped mine.

MR. JAMES: It wouldn't be undeveloped.

MR. MANNING: I think a provision of that sort ought to be inserted to have the mine worked to full capacity.

MR. NATHAN L. STRONG: Did I understand you to say the sulphur in the coal is more valuable than the coal itself?

MR. MANNING: At present; yes, sir.

MR. STRONG: I was interested in that. There is one vein of coal in my district with such a high percent of sulphur it is known as the Sulphur vein.

MR. MANNING: A good deal of it has sulphur.

MR. STRONG: It comes out in great slabs.

MR. MANNING: Yes, sir.

MR. SANDERS: I had a man in my office to tell me that he got more for his sulphur than for his coal. That was in peace times—two and a half years ago.

MR. MANNING: I would like to explain the provisions of Section 14 of this bill. This section provides that duties may be placed upon the import of necessaries sufficient to bring the price of the imported article up to the same level as any guaranteed minimum price which may be established under this bill. This provision is put in the bill solely for the purpose of protecting the United States government. The Government having once established a guaranteed minimum price must, to make it effective, purchase such ores as are offered it at that price, for the period of the guaranty, which may be two years. In case of a sudden ending of the War, or an improvement of the shipping situation which would permit import, foreign necessaries might be imported at lower prices, unless this provision were made, thereby compelling the Government to purchase all domestic material at the higher guaranteed prices and increasing the liability of the Government to this extent.

MR. HAMLIN: That same provision was put in the agricultural bill or a similar one.

MR. MANNING: Yes, sir; we followed very closely the agricultural bill in framing this.

MR. JAMES: When the powder bill was up, you remember, this language "accept the services of any person without compensation", and then a little further, "any person may be employed under the provisions of this act without reference to civil-service laws and regulations." I believe in civil service. At that time you stated it was not the intention of giving Democrats or anybody else a job but simply to take care of a good many men who wouldn't want to take any civil-service examination whatever. You wanted to use them without getting their services for nothing, and at the same time you wanted to take care of that.

MR. MANNING: I will give you a concrete illustration. In the explosion at Jersey City, instead of our bureau sending an expert, Mr. Topping, who was Director of the Bureau of Explosives, a bureau that is organized and financed by the railroads of the country, went there. He is getting a dollar a year. He made a prompt report to the Bureau of Mines as to the causes of that explosion. We had to give him a dollar a year so as to give him entry to the manufactories and all plants where explosions occur.

MR. JAMES: And this bill today was not for the purpose of the civil service, but using them any way you could get them?

MR. MANNING: I will say for the Civil Service Commission that they joined in a request to the President to remove all war work the Bureau of Mines is doing from the provisions of the civil service. We use the civil service just as far as possible, but we are up against a hard proposition to find employees for the Government today.

MR. JAMES: The last time we had a hard fight on. We had a hard time working it up and your statement saved it.

MR. MANNING: I see no objection to taking the civil service provision out of there. They realize that we are at war, gentlemen, and they are willing to do their part.

MR. WINGO: In other words, there is very full co-operation between the civil service and all the departments so that war work will not be hampered?

MR. MANNING: I can say that if you take the civil-service bars down when the War is over it may be disrupted.

MR. WINGO: They realize the necessity of taking the civil service from certain departments to get men who can do the work.

MR. MANNING: Yes.

MR. GARLAND: Have you made a statement there anywhere in print showing the source of the different articles —what manufactures they go into, for instance? Do a large number of them go into steel?

MR. MANNING: Yes; I have covered that in a former statement.

MR. SANDERS: You think the provision in Section 2, which authorized the President to delegate any authority under this act—

MR. MANNING: One main controller.

MR. SANDERS: Section 2, line 22, the provision authorizes the President to delegate any of his authority under this act to any agent or agencies.

MR. MANNING: He would be compelled to delegate his authority because he is too busy with many matters and would have to delegate authority to somebody to draw up the regulations to carry out the provisions of this act.

MR. ANDERSON: I understand that. Of course, a great many things the President does he must do through agencies, but it really gets his approval in the end and when it has his approval in the end it is considered his act and not a delegation of authority to some one else to do it. Under that there is a provision authorizing the President to delegate that authority to anybody else to make the regulations that he should desire?

MR. MANNING: That might be modified in this way: Of course, you can't say beforehand who the agent is

going to be selected by the President unless you yourselves put in the bill what agency it is to be, and if that agency is selected by Congress the regulations to be prescribed might be drawn up by that agency and approved by the President. Otherwise, it seems to me the President would have to delegate some of the authority under this act.

MR. WINGO: Isn't this the practical operation of it: If you didn't put that in there the President would be compelled in all of these agreements, etc., to sign the agreements when he would be unable for physical endurance to sign them. He would have to delegate it to somebody else. It would be simply impossible to read over all these regulations and inform on them, and he would have to rely on somebody else, and by putting this provision in you would permit him to do that by act of Congress and save him the physical labor of signing innumerable orders that he couldn't possibly pass upon?

MR. MANNING: The President would not be relieved from his authority by simply delegating somebody else—

MR. SANDERS: In the administration of fuel he delegated authority to the Fuel Administration, and he delegated it to the State fuel administration, and he delegated it to the county fuel administration, and the county fuel administration delegated that down to the township fuel administrator, and we have different arrangements in different places to carry out things which are entirely inconsistent. For instance, in the making of the regulations don't you think it would be wise to have the President act—I really think a violation of some of these regulations is to be a criminal offense—to the President of the United States. To be sure, he will not do it himself, but they will be his acts nevertheless, and when he signs his name to it and when the proclamation is issued the regulations will contain his name.

MR. MANNING: Under the explosives act we followed that method. The regulations were to be prescribed by the Bureau of Mines and approved by the President.

MR. WINGO: I have read this act as best I could. I think my friend has gotten a mistaken idea. I don't think there would anywhere be a criminal offense committed by a man for not following the provisions of it. We fix a penalty for violation of this act. Hoarding, under Section 4, any wilful violation of this section, shall be subject to fine. On page 7, any person who wilfully hoards shall be fined, and on the bottom of page 6 you will find the regulation for "any person who without a license issued carries on the business." It is not because he violates the regulations, but it is because he undertakes to do business without doing what Congress has prescribed he shall procure. And on page 8, "any person who destroys 'necessaries' shall be fined," and in the next section, "any person who conspires, combines, agrees, or arranges with any other person, or who aids or abets any other person (a) to limit the facilities for transporting, producing, manufacturing, supplying, storing, or dealing in any necessaries; (b) to restrict the supply of any necessaries; (c) to restrict the distribution of any necessaries; (d) to prevent, limit, or lessen the manufacture or production of any necessaries in order to enhance the price thereof, shall, upon conviction thereof, be fined not exceeding $10,000 or be imprisoned for not more than two years, or both." So I think, my friend is mistaken about that as an abstract proposition. I looked for that, because I looked for criticism on that score. Nowhere would it become a criminal offense for a man to violate the regulations given him by the President, and my object in calling attention to it was that I didn't want the idea to get into the record we were permitting a man to get into the penitentiary—

MR. SANDERS: Under those provisions—take Section 15, page 16—there is a provision that when the President shall find that limitation, regulation, or prohibition of the use of any of these necessaries is essential in order to assure an adequate and continuous supply of necessaries, or that the national security and defense will be subserved thereby, he is authorized, from time to time, to prescribe and give public notice of the extent of the limitation, regulation, prohibition, or reduction so necessitated. Whenever such notice shall have been given and shall remain unrevoked all persons shall, after a reasonable time, prescribed in such notice, conform to the order providing such limitation, regulation, prohibition, or reduction. Any person who wilfully violates the provisions of this section, or who shall violate any rule or regulation made under this section, shall be punished by a fine not exceeding $5000 or by imprisonment for not more than two years, or both.

MR. WINGO: Yes; and we have that in frequent acts. Whenever a President issues a proclamation, there is a formal notice. If he unwillingly violates it he is not guilty, but if he wilfully violates a proclamation made down by the President of the United States—

MR. SANDERS: That is what I say, the violation of the proclamation is made a criminal offense.

MR. WINGO: Yes; but he violates it, and he must have knowledge of it before he is guilty.

MR. SANDERS: I know; but you have to hunt up to whom the President delegates the authority.

MR. WINGO: You think that section would authorize somebody else to issue a proclamation?

MR. SANDERS: Yes; Section 2 says he may delegate anybody to do anything in this act.

MR. WINGO: I don't think the President could delegate somebody else to issue a proclamation of the President of the United States.

MR. SANDERS: It is in that section.

MR. WINGO: I don't think that would be taken into consideration.

MR. MANNING: Those of us who drew this bill will have to apologize for the phraseology. We followed the agricultural bill.

MR. DENISON: Do you think that by enactment of this legislation or the principles of this legislation that we can in this country produce, develop and produce, these necessaries mentioned in the bill to sufficient extent to gradually if not ultimately supply our own needs?

MR. MANNING: With some few exceptions. Tin and

platinum—we are getting our platinum, as stated here yesterday and day before, very largely from Russia. A gentleman from the Ordnance Department called me up yesterday saying he wanted to negotiate for the purchase of platinum from Russia; he wanted to know how he could determine whether or not he was getting the pure article. I called his attention to the fact that we could get platinum from Colombia. There is a possibility of it in this country, also a possibility of getting it from the black sands of the Pacific coast. So far as tin is concerned, there is very little of it in this country. But I believe with American ingenuity we can find a substitute for it; we have done it for many commodities in the past.

MR. WINGO: Tin is of importance now?

MR. MANNING: It is an absolute necessity.

MR. HAMLIN: I want to ask you a question about it: I take it, if this bill becomes a law that duty will devolve very largely upon you?

MR. MANNING: I don't know that it will.

MR. HAMLIN: Well, somebody connected with the Bureau of Mines. It was suggested yesterday that there might be some objection to the licensing provision, commencing on line 14, page 15.

MR. MANNING: I think the license feature ought to be in. You are up against conditions now that should be controlled. For instance, suppose the Government should take over these two big sulphur mines in Texas and Louisiana. You would not only have to license the consumers but the producers. Some of this sulphur going into non-essential industries might have to be restricted.

MR. HAMLIN: I think Mr. Baruch has called special attention to this language in the bill, "that whenever and wherever the President in his judgment finds it necessary to fix the price and regulate the method of production, sale, shipment, distribution, apportionment, and storage that among dealers and consumers, domestic or foreign," would without a licensing feature give him ample authority. Personally, I like that license feature myself.

MR. MANNING: The only objection to the license system would be the enormous machinery you would have to handle, but it is only contemplated to license when it becomes necessary.

MR. HAMLIN: Have you had any trouble in administering the explosives law we passed last session?

MR. MANNING: None whatever. I have been much gratified with the ease with which that law is being operated.

MR. HAMLIN: Do you know of any reason why this couldn't be operated with the same ease?

MR. MANNING: I do not.

MR. GARLAND: Wasn't there considerable objection on the part of the small dealer to licensing?

MR. MANNING: Not that I heard of.

MR. GARLAND: Some of them told me they would not take out license; they would rather not sell.

MR. MANNING: I have heard of no real objection. All a man has to do is to be vouched for as to his loyalty and the license follows.

MR. SANDERS: Doesn't the license help you keep an inventory of what is going on?

MR. MANNING: No question about it. The Government was unable to get a complete record of the explosives plants in the United States until this law.

MR. SANDERS: Would you suggest that we make the license feature the same in the bill as we did finally in the explosives act, a 25-cent fee?

MR. MANNING: I don't know but what that ought to be in there.

MR. SANDERS: If you charge a fee it ought to be in the bill so as to show the authority, and no one would raise the question of the authority for doing it.

MR. MANNING: It might relieve the Government of the big expense of doing it. The consumer pays for the license.

MR. JAMES: A little while ago you said regarding that with American ingenuity and a little money something could very likely be done. Do you figure under this bill you could spend any money to help get any more manganese?

MR. MANNING: It isn't contemplated under that. The Bureau of Mines has $150,000 recently given by Congress, and an estimate of $100,000 more from the 1st of July, which will enable us to get valuable information concerning our mineral resources.

MR. JAMES: You didn't contemplate the appropriation of any money for this?

MR. MANNING: No, sir.

MR. LONDON: The suggestion was made yesterday of the establishment of a licensing system, that it would require the maintenance of a cumbersome machinery. You don't agree with that view?

MR. MANNING: Not if administered in the way we administered the explosives bill.

MR. LONDON: What are the technical ways for getting a license or applying for a license? A man applies for license in a written application?

MR. MANNING: Yes, sir. Under the provisions of the explosives law we have ten or twelve thousand licensing agencies in the United States, and it is easy for a man to go and get a license.

THE CHAIRMAN: As I understand, the county clerk is an agent?

MR. MANNING: Yes, sir; and every one of those clerks has been examined as to his loyalty.

THE CHAIRMAN: Are you having any trouble in getting any of these county and State officials on that duty?

MR. MANNING: Only by the State law. Some State laws require that the fees shall be turned over to the State treasurer.

THE CHAIRMAN: I know in one State they claim that there was some violation under the 'draft act,' and they prosecuted a man for it, and his contention was that the Congress had no authority to interpose that provision upon him, and the court held that he was right and he was discharged.

MR. SANDERS: That was the prosecuting attorney for my county. He was advised that he must advise the exemption boards. They hadn't called upon him, but they

trumped up a charge on him that he hadn't advised them about their duties. It wasn't any hesitancy on his account to do what the law asked him to do.

MR. MANNING: The purpose of the license is to restrict its use, the possibilities of restricting its use in certain non-essentials, and to create zoning districts.

THE CHAIRMAN: Would it destroy the efficiency, from your viewpoint, if we put in the law providing that all these people that are now dealing in these articles shall be licensed by the act, and as you find them unworthy of exercising the authority they should be revoked?

MR. MANNING: I think they should be revoked.

THE CHAIRMAN: The point I wanted to get at is, would it destroy the efficiency of what you are trying to get at by providing that all of the users and producers are hereby licensed?

MR. MANNING: I don't think that could be done. My understanding of the word 'license' means this—I will give you a concrete illustration of what the Food Administration did: All of the arsenic users were licensed because arsenic was needed for the War. The glass industry was told they couldn't use it, because they could get along without it, and told them what they could take in its place. What we may have to do is to apply the license and restrict its use. We want to encourage the production of it.

THE CHAIRMAN: Couldn't you license them under the law and wouldn't it save quite a——

MR. HAMLIN: His point is that the only remedy he would have if they didn't cease using it would be to revoke their license.

MR. MANNING: Under the operation of this bill we wouldn't start out to license any of the producers. We would say go ahead and produce all you can, but the time might come when we would want to take care of the material and apply a license, so as to get sufficient quantities for use.

MR. DENISON: I think it is very important to have the license, so as to limit the people who are to use it.

MR. SANDERS: The task of licensing people under this act would not be near so great as under the Food Administration act?

MR. MANNING: No, sir; because of the limited number of producers. We wouldn't want to discourage these producers by restraining them with a license. We want to protect them.

MR. JAMES: There are 14 or 15 minerals here. You don't have to use the license on more than one if you don't think it is necessary?

MR. MANNING: We may not have to apply it to any one.

MR. SANDERS: It is all up to the President, under section 5, to decide when that license is necessary?

MR. MANNING: Yes, sir.

ALUM is in large demand by manufacturers of paper, but transportation facilities are hard to get. The prices for lump ammonia alum are from 4 to 4½c. per pound; for lump potash alum, 8 to 9c.; for chrome-potash alum, 20 to 21c.; and for chrome-ammonia alum, 18 to 19 cents.

American Zinc Institute

At a meeting held at Joplin, on June 6, 1918, of mine-operators representing 88% of the total production of zinc ore produced in the Oklahoma, Kansas, and Missouri zinc districts, and controlling 35% of the present spelter production of the United States, there was formed an organization named the American Zinc Institute.

At this meeting complete zinc data relating to the zinc mining and smelting business of the United States were submitted. Correlating the data presented, the following facts relating to the mining and smelting industries were established:

1. The zinc industry met the requirements of the Government and of our Allies, as well as the requirements of the trade, during the first years of the War, and practically doubled production to meet this demand.

2. After the sudden reequirements for war purposes were met, and the demand from this source decreased, there was likewise a marked decrease in consumption by the trade, because such industries as used galvanized products were diverted to the manufacturing of more essential war-materials.

3. It is estimated that during the life of the War the controlling consumption factor will show little betterment. Furthermore, the production factor in both spelter and ore can be controlled to exactly the requirements.

In the line with governmental policies clearly set out in many of the other industries and fairly administered by the War Industries Board, the following plans have been laid down:

(1) That each industry should strive to secure to the Government its necessary product, as well as that of the Allies and the trade, during the War.

(2) That consumption and production in any commodity should be equalized as nearly as possible, so that any industry embodying within itself non-essential factors shall release these factors for essential work. Thus each industry will release men, food-supplies, transportation, and capital for the more important and essential requirements of the Governments.

(3) That in order that our Government and the industries of this country may best lay plans for future export trade, it is necessary that those industries now suffering because of war and trade conditions shall be maintained as nearly as possible in a position enabling them to take advantage of foreign trade at the end of the War.

OIL PRODUCTION of the fields east of the Mississippi in 1917 was as under, according to the U. S. Geological Survey:

Field	Barrels	Increase or decrease, %
Appalachian (Pa., Ohio, W. Va., Ky., Tenn.)	24,907,176	+ 8
Lima-Indiana	3,669,963	— 6
North-west Ohio	2,901,861	— 7
Illinois	15,770,641	— 11
Indiana	759,102	— 1

The average price received at the wells for all grades of Appalachian oil marketed was $3.11 per barrel, a gain of 65 cents over the price in 1916.

New Fume-Treatment Plant at Anaconda

By D. M. BROWN

A smoke-treatment plant, estimated to cost $2,000,000, including the largest chimney in the world, is now under construction at the Washoe smelter, the reduction plant of the Anaconda Copper Mining Co., at Anaconda, Montana. The new plant is intended to recover a large quantity of the metalliferous dust now being discharged with the fume, all the arsenic, which now escapes, and a large portion of solids that are carried with the smoke. This requires the building of a plant containing Cottrell treaters, a power-house, and the large chimney. The old stack is inadequate to carry the fume from the reverberatories, converters, and roasters.



CONCRETE FOUNDATION OF NEW ANACONDA STACK

In a northerly direction from the present stack will be two flues, each 20 by 50 ft. inside, one flue on the east and one on the west. These flues will lead to 20 Cottrell smoke-treaters of the Anaconda type. The Anaconda box-type Cottrell treaters were developed at the Washoe smelter. The Cottrell treaters of the old type consisted of a series of pipes of different sizes, averaging about 12 in. diameter; through the centre was strung a wire to carry the electric charge which caused the dust in the gases to drop. In this system the electric charge utilized the inside of the pipe only, losing the value of the outer surface; the box-type treaters use the whole surface.

Treaters of the box type consist of a series of corrugated iron plates about 24 by 21 ft., placed in parallel and hung about 12 in. apart. Between the plates, chains are hung that are charged with approximately 75,000 volts, and suppported by insulators on a gridiron framework. The chains are connected to the negative pole, and the plates are grounded, resulting in a discharge from the chains to the plates. The dust-laden fume coming into the sphere of this electric action throws out the dust from the gases. The dust-particles become charged negatively and are attracted by the positive plates to which they cling until shaken by automatic shakers into hoppers provided for that purpose. Once the momentum of a moving dust-particle is retarded it is impossible for it to regain speed enough to ride with the fume. Electric power will be furnished by a 75-kva. single phase generator directly connected to a motor. A rectifier of the Anaconda type, 48 in. diameter, will be connected directly to the generator, changing the alternating into direct current to go to the chains.

A flue in four sections will be constructed opposite the treaters. Gas leaving the bottom flue on one side will pass through the treater where the solids are removed, and thence it will return to the upper flue which leads to the new stack. Dust caught in the main treaters is taken to a reverberatory furnace in small steel cars and charged with appropriate amounts of calcine, fluxes, and other materials.

The main flues will be built of steel and brick, the latter being in the form of hollow tile. Construction of the main flue will require 900 tons of steel and the hollow tile used will be equivalent to 2,500,000 common brick, weighing 7500 tons. The flues will pass 3,000,000 cu. ft. of gas per minute, carrying about 280 tons of solids per 24 hours, traveling at the rate of six feet per second.

It is expected that the treaters will catch 240 tons of solids per 24 hours or about 88% of the entire amount now going to waste. There will be 20 main treaters, five on each side in both flues, and each treater will be 20½ by 26 ft. inside. The building of the treaters will require 2600 tons of steel and tile, equivalent to 5,500,000 common brick, weighing 16,500 tons.

The reverberatory furnace for treating the dust will be 20 by 100 ft., and the steel building 68 by 154 ft. This building will be entirely of steel and will require 320 tons in its construction. The furnace will be fired with coal dust, consuming an average amount of about 60 tons per day. The charges used will consist of 240 tons of the main-treater dust, 45 tons of hot-treater dust, with 155 tons of calcine, flux, and other material. There should be an output of about 50 tons of matte and 200 tons of slag per day from this furnace.

This reverberatory furnace discharges fume, containing considerable dust and also volatilizes all the arsenic in the charge. The arsenic is recovered by leading it through a flue to a hot Cottrell treater where the remaining dust is deposited. The flue leading from the reverberatory furnace to the hot Cottrell treater is 33½ by 11½ ft. inside, requiring hollow tile equivalent to 376,000 common brick and weighing 1128 tons. The steel used in this flue will weigh 45 tons.

From here the gas enters a hot-treater. There will be three of these, 13 ft. 2½ in. by 23 ft. 6 in. inside, requiring tile equivalent to 75,000 common brick, and 400 tons of steel. The recovery in these treaters will be about 45 tons of dust per day with a gas-velocity of two feet per second. The escaping arsenic fume is carried through a flue and cold air is introduced at this point to bring the temperature down sufficiently to allow the arsenic to be deposited. The arsenic flue leading from the hot to the cold-treater will be 34 ft. 6 in. by 12 ft. 2½ in. inside, and will require hollow tile equivalent to 305,000 common brick, and 100 tons of steel. This flue leads to three cold-treaters, each 13 ft. 2½ in. by 23 ft. 6 in. inside. The gas velocity through the cold-treater will be about three or four feet per second. The arsenic fume led into the cold Cottrell treater is caught there. Any escaping gas or fume from the hot-treater is carried through a flue to the main flue ahead of the main Cottrell treaters, making a closed circuit for the arsenic. There will be a recovery of about 35 tons of arsenic, 92 to 95% pure, each 24 hours. This will be shipped direct from the treater in that form, without further refining.

From the cold-treater to the main flue will be another flue 20 ft. by 12 ft. 2½ in. inside, equivalent to 206,000 common brick, weighing 618 tons, being the last link from the Cottrell apparatus to the big chimney. It is estimated that not over 15% of the dust will be carried away with the gases.

The electric current for the Cottrell treaters will be furnished from a power-house measuring 50 by 100 ft., and having a shop 21 by 43 ft., built of brick, steel, and concrete. The electric installation consists of 16 units; each unit a 75-kva. 220-volt single-phase generator, direct connected to a 115-hp. 2200-volt motor running at 1760 r.p.m. There will be a rectifier directly connected to the driving shaft of the generator to change the alternating to direct current, in which form it goes to the treaters. This power will be developed at 75,000 volts.

The new chimney, which is the largest in the world, will represent about 20% of the new investment in plant. The Alphonse-Custodis Co. of New York will construct the huge affair in approximately four months, using as much machine-power as possible, and a crew of 50 men. As the stack grows in height it is followed by an elevator tower built with compartments for seven cages. The speed of running will be 750 ft. per minute. The construction will require 2,300,000 radial brick, the equivalent of 7,000,000 common brick. The diameter of the chimney at the top will be 60 ft. and it will stand 525 ft. above its concrete foundation. The Tacoma stack has a diameter of 23 ft. and stands 571 ft. high. The draught-height of the Washoe stack, due to its position on a hill top, will be increased 454 ft. from the reverberatory to the top of the new stack, equal to a draught-column 979 ft. high. The chimney will have two flue openings, each being 61 ft. wide and 60 ft. high. For a distance of 68 ft. above the foundation the chimney will be octagonal and from that point it will be round. This stack will transmit 3,000,000 cu. ft. of gas, plus 1,000,000 cu. ft. of cooling-air, or a total of 4,000,000 cu. ft. per minute, at a velocity of 24 ft. per second.

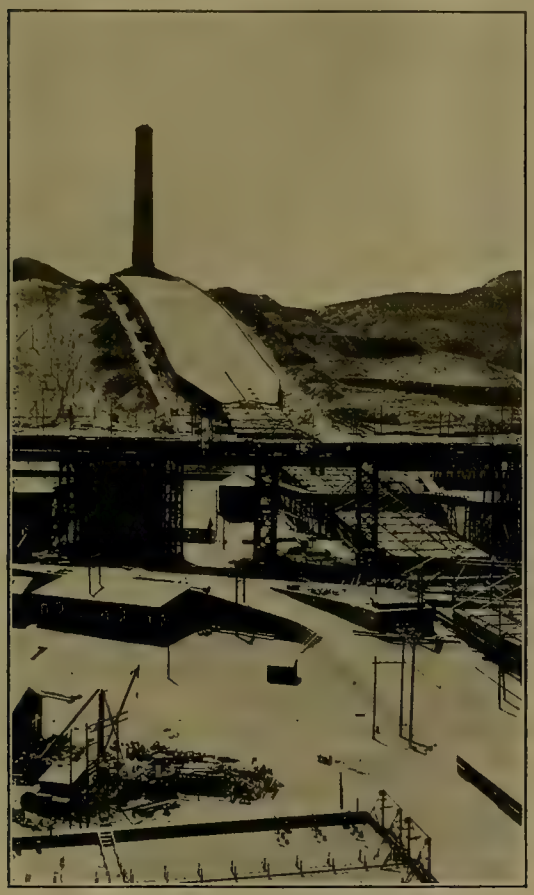
The new stack will be used entirely to conduct fume from the smelter to the higher atmosphere. All other chimneys now in use will be eliminated and their flues connected to this main one, and all the fume will pass through the main flue and the Cottrell treaters. The increased draught will avoid the escape of gases, which now is common about the works.

A record was made in the pouring of the foundation for this great stack last fall. It took but 24 shifts to pour 5000 cu. yd. of concrete, and one of the shifts was spent in machine repair so that the actual time was but 23 shifts. The pouring of an equal volume at the Tacoma stack required 45 shifts and the foundation of the Japanese chimney, consisting of 2711 cu. yd., required 90 shifts to pour.

Comparison of the World's Largest Stacks

	Brick				Reinforced concrete
	New stack, Anaconda.	Old stack, Anaconda.	Great Falls.	Tacoma.	Sacamoseki, Japan.
	ft	ft in.	ft in.	ft in.	ft in.
Inside diam at top.	60	30 0	50 0	23 11	26 3
Inside diam at bottom	76	31 4	. . . .	39 0	37 9
Thickness of wall at top	18	12 6	18 0	13 6	0 7
Thickness of wall at bottom	5	5 2	5 6	5 1	2 5½
Height above foundation	525	300 0	506 0	571 0	570 0

For the construction work and as a permanent trackage for hauling material, three miles of main-line spur and switch-back had to be built, and also a wagon road



OLD ANACONDA FLUE AND STACK

a mile long. In excavating and grading for the wagon road and for the site of the plant nearly 85,000 cu. yd. of earth and rock were moved.

Three important results will be obtained by the installation of the new Cottrell plant, namely, the saving of metalliferous dust, the elimination of gases about the plant, and the improvement of agriculture in the Deer Lodge valley. The arsenic that fell upon the farm lands of the valley has given rise to complaint and litigation in the past, but with the elimination of this factor real-estate values in the adjacent country will advance.

The men responsible for the construction of the plant are Fredrick Laist, the general manager of the smelters for the Anaconda company, W. C. Caperon, the mechanical superintendent for the company, under whose immediate direction the construction is made, and J. K. Murphy who will superintend the new plant, he having had charge of the experimental Cottrell treaters now in use at the works. It will stand out as the most notable equipment in America for the abatement of fume difficulties, considered both as to the effect on agriculture and as to the loss entailed on the smelter by the valuable products ordinarily swept into the atmosphere.

A NEW separation of tin and tungsten in stanniferous wolfram is given in the 'Compt. Rend.' (165, 408-10) as follows: Pulverize the mineral carefully and fuse it with anhydrous Na_2SO_4. Take up the fused mass with boiling H_2O, dilute the solution to 700 or 800 cc., and acidify it slightly. The brown SnS precipitate obtained entrains with it some SiO_2 and sulphides of Mn and Fe, but no H_2WO_4. To purify the precipitate dissolve it in $(NH_4)_2S_2$, re-precipitate it as SnS_2, and calcine it to SnO_2. To determine the tungsten fuse another sample with Na_2SO_3 and take up the mass directly with aqua regia, causing thereby the precipitation of the major part of the H_2WO_4 along with SiO_2. The separation is not quantitative, however, because of the presence of metatungstic acid. Treat the filtrate, which should contain Fe (the 10% usually present in the mineral is sufficient) with NH_4OH, without excess, to bring down the $Fe(OH)_3$, which entrains the tungstic acid. Wash the precipitate free from sodium salts, dissolve it on the filter with 50% HCl solution, evaporate the filtrate to dryness, and take up the residue with HCl. Separate the SiO_2 by the ordinary methods. The H_2WO_4 retains only traces of iron, less than 0.2 mg. Fe_2O_3.

EFFECT of rate of application of load on the compressive strength of concrete is discussed by D. A. Abrams, in the Proceedings of the American Society for Testing Materials. He points out that in compression tests of concrete, the rate of application of load has an important influence on its strength. Tests were made at the structural-materials laboratory of Lewis Institute, Chicago, on 270 concrete cylinders, 6 in. diam., 12 in. high, with mixes of 1:9, 1:5, and 1:3. Two methods of loading were used: 1. About 10% maximum load was applied at a fast rate (0.25 in. per min.) and the remainder of the load applied at rates from 0.006 to 0.15 in. per minute. 2. About 88% of maximum load was applied at a fast rate (0.25 in. per min.) and the remainder at a rate of 0.01 in. per minute. For the richest mixes, tested at 28 days, the strength, when loaded at 0.15 in. per minute, is 14 to 20% higher than when loaded at 0.006 in. per minute. If part of the load is applied at a fast rate and the rest at a slow speed the ultimate strength of the concrete is unchanged. A machine-speed which gives a shortening of the test piece of 0.01 to 0.02 in. per minute per foot is recommended as a standard rate for compression tests of concrete.

Engineering Council Seeks Helpers

The Engineering Council, as was designed, is engaging in numerous activities for the engineering profession of America, many of these activities being directly or indirectly connected with the War. The Council is a body of representatives from member-societies conducting most of its work through committees. For effectiveness these committees have usually a small number of members, although committee-membership is not limited to the representatives on the Engineering Council. Men have been selected for committee-membership because of broad knowledge and extended experience in the field. As the work of some committees develops, however, there are occasions when helpers are needed who can devote time to details, to special investigations, to getting local information in some community or State, to compiling and analyzing information already accumulated, or to scouting for men needed for some particular service. When need arises for such assistance it is often difficult to think of or to find the right man available at that moment. In order to meet this difficulty, to give a larger number of engineers a share in the activities, to broaden the Council's contact and gain greater breadth for its views and statements, as well as to make its work more widely known, the Engineering Council is requesting engineers who can help, to register their names and addresses, and in a general way stating the extent and nature of the service each is willing to render. This is an opportunity for some of the younger members of the profession to take a hand in society activities, but the request is not limited to the men of few years. Of course, every one registered may not be called upon or it may be a long time seemingly before a given volunteer is asked to help. On the other hand, calls may come promptly and frequently and opportunities may be afforded for service of no small value to the profession and the public.

To indicate a few lines of the Council's work, brief statements are given about some of the committees. The Public Affairs Committee reports on matters of public policy, and those relating to National, State, or local government, other than technical questions. One question of active interest now before this committee, for example, is that of licensing engineers.

The American Engineering Service has the duty of compiling as complete a classified catalogue of the engineers of America as it may be practicable to get together. Much information has been assembled, but a great deal remains to be collected. During war time lists collected by this committee and the engineering societies co-operating with it, are being used to supply thousands of names in response to calls from Government departments for specialists for combatant and other forces of Army and Navy and for the war industries. This committee frequently could use volunteers not only in New York but in distant communities, also in scouting for men to meet special and urgent calls from the Government, as well as in other ways. The War Committee of Technical Societies is engaged upon the examination of new inventions offered to the War and Navy departments and to stimulation of the development of useful new appliances for warfare. In reviewing ideas received, preparing bulletins and writing reports and records, this committee could make use of a number of helpers from time to time. The Water Conservation Committee is organizing to deal with questions of policy in various parts of the country concerning the utilization and control of water for such purposes as power development, navigation, irrigation, and municipal supply. This committee will need correspondents to aid it in keeping informed or in making special investigations about local laws and policies.

Engineers who are able and willing to take some part in this service for the profession should communicate with Alfred D. Flinn, Secretary of the Engineering Council, 29 West 39th St., New York.

CORRELATION between bacterial activity and lime requirement of soils was the subject of experiments made by F. E. Bear on two acid soils, which had received no lime or fertilizers for a number of years. Tests were conducted to determine the effect of $CaCO_3$, in amounts ranging from 250 to 40,000 lb. in 2,000,000 lb. of soil, in the following: The number of bacteria, the rate of ammonification, the rate of nitrification, the fixation of nitrogen by non-symbiotic organisms, and the development of bacteria radicola of the soy bean. The greatest relative increase in the rate of ammonification of casein per unit of $CaCO_3$ applied, occurred with the application of 2000 lb. of $CaCO_3$ per 2,000,000 lb. of soil. There was no marked increase as the neutral point was passed. Amounts as high as 20,000 and 40,000 lb. caused a slight decrease in ammonification. The addition of $CaCO_3$ is followed by an increased nitrification, which correlates almost directly with the increased applications of $CaCO_3$, up to 5000 lb. per 2,000,000 lb. of soil. There is not a corresponding increase above 5000 lb. There is no close correlation between the increased number of bacteria in the soil and the rate of nitrification except that in general the applications of increased amounts of $CaCO_3$ caused an upward tendency in the number of bacteria as well as in the rate of nitrification. The number of root nodules of soy beans had a tendency to increase in these acid soils with small applications of $CaCO_3$. The application of $CaH_4(PO_4)_2$ was necessary for maximum N fixation. This was decreased with large applications of $CaCO_3$. The pulverizing of limestone is becoming a great industry in this country, as the value of such material becomes better appreciated. Pulverized limestone, gypsum, and sulphur all promote nitrogen-fixation in soils to a remarkable degree. The greatest advantage is obtained when all three are used together on soils rich in humus.

CYANIDE OF SODA is not in heavy demand at the present time, and producers are asking 37c. per pound, while re-sale material is quoted at 40c. in carload lots, and at 42c. in smaller quantities.



SAN FRANCISCO, CALIFORNIA

The Antimony Situation Discussed at a Public Conference.

The United States Tariff Commission held a public conference on the antimony industry at San Francisco on June 24. W. S. Culbertson was chairman, with Guy C. Riddell as metallurgical expert. There were 20 present, exclusive of officials. Producers were called first:

H. J. Hibschman, representing the Coeur d'Alene Antimony and Star Antimony companies on Pine creek, near Kellogg, Idaho, said that the deposits were worked 20 years ago. A mill and flotation plant is ready to work at the former. The other property is not much developed, and is closed at present. There is another antimony mine near Wallace. Gold is associated with antimony in Pine Creek ores. Chinese competition he considers too severe for domestic operation.

M. E. Jolley of the Couer d'Alene Antimony Co., Idaho, stated that labor and supplies are very high. In 1915 the market was high, then it dropped suddenly, resulting in the present situation. He had investigated the caustic-soda and electrolytic methods of extracting the metal.

Chalmer Munday represented F. S. Houghland of Montana. In the Burns district, 15 miles out of Thompson Falls, considerable deposits have been worked irregularly for 20 years. Some shipments in 1915 resulted in loss. A local oxide plant was erected for low-grade ore. No work is being done now on account of the uncertainty of the market. He considered 25c. per pound a desirable price.

C. N. Miller represented Miller & Thompson, operating on the West Coast of Sonora, Mexico. Their ore is an oxide, but deposits are irregular. They have been shipping 400 tons per month, hauling 110 miles to Santa Ana by wagon. They prefer to mine in the United States but economic conditions in Mexico are better, especially with cheaper labor. The wage is ₱2 per day, equal to $1 in the United States. The pay in China is 10 to 40 cents. The Mexican ores carry no impurities. The present price is too low, although they are just making ends meet. He suggested a higher tariff on metal in ore. It costs $60 per ton to place ore at Harbor City, Los Angeles, by wagon and rail.

The smelter interests were called next:

M. Elsassar of the Western Metals Co., Los Angeles, an authority on the subject, read a prepared statement. Labor is the deciding factor in antimony production everywhere, and we have to combat cheap help as in China, Bolivia, and Mexico. It is pre-eminently a war metal. It is generally stated that there are no American deposits of importance. They are admittedly erratic. The market in past years has hindered development. Practically no machinery has been erected at antimony mines on account of the market. The present tariff is no protection. A duty of 2c. per lb. on metal in ore is desired, and 6c. on metal and products. Great Britain has fixed antimony at 18.6c. per lb. A Chinese product (71.8% Sb) can be landed in New York at 11c. The trade requires the 'star' metal, which is unnecessary. Antimonial-lead ore is ignored. Machinery is not a factor in mining and smelting. Stibnite can easily be floated. Kern county, California, has large possibilities. The antimony consumption of the United States is now 1500 tons per month, about double the normal. A reasonable price is 16 cents, and the miner could be paid a fair price, that is, the Chinese cost of 10c. plus 6c. duty. There is no monopoly of the metal in America. $85 per ton for 50% ore should be profitable mining; this is equal to $1.75 per unit. France has a considerable antimony industry protected by a tariff. The Western Metals Co.'s costs are 5½ to 6c. per pound for smelting and freight to New York. Antimony producers have asked the War Industries Board to fix the price, otherwise they want a duty. The Chinese cost plus a duty would fix the price.

W. C. Chalmers, connected with the Wah Chang Mining & Smelting Co., did not think it was worth while fostering so small an industry. The Chinese export duty on antimony is 5% on the value of the product at point of shipment.

G. McN. Ross gave the attitude of mine-owners and lessees especially of Kern county, California; Humboldt county, Nevada; and Alaska. The men wish to do all in their power to help the industry. He thinks that there is a great deal of antimony ore in America. The Nevada sulphide ore is easily sorted and concentrated, but the oxide is not. He gave some interesting views on the tariff; and thought that with a high price the output of antimony should improve just as it stimulated chrome mining.

Fletcher McN. Hamilton, State Mineralogist, said that until 1915 there was practically no interest taken in antimony production. Up to 1915 there was 510 tons produced. From July 1914 the price increased from 5½ to 44c. in January 1916, due to speculation. Californian deposits are in Kern, Inyo, and San Bernardino counties. In 1916 the output was 1015 tons of ore, and in 1917, 150 tons, concurrent with the drop in price. Production follows high prices, and there is little at present. There is no stability in the market; this curtails prospecting and development. A protective tariff is advisable.

Fred West, chemist of the U. S. Customs, said that a shipment of needle antimony in May 1917 came to San Francisco, the first for several years, from the Wah Chang company, in China. There was no classification for this, carrying 71.4% antimony. It was eventually termed matte. A duty of 10% is charged on it. His views led to an interesting discussion on what was antimony metal and what were the ores, etc. Guy C. Riddell considered the terms in the antimony trade as very confusing. W. W. Bradley, of the State Mining Bureau, gave definitions of concentrate and crude, as used metallurgically, distinguishing them from the antimony trade terms.

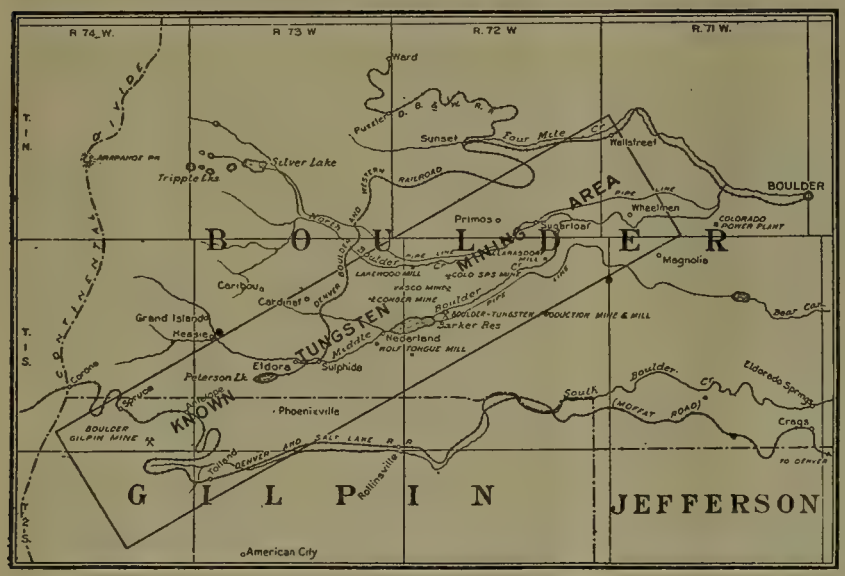
F. L. Ransome, of the U. S. Geological Survey, said that no estimates had been given by witnesses on the reserves of antimony ore in this country.

C. Solomon Jr., of the Chapman Smelting Co., San Francisco, was very deliberate. He said that the Chinese sold ore in London prior to the War at £5 or £6 ($24 to $29) per ton. A duty of $10 per ton would not prevent them from shipping it to the United States and smelting it here, so eliminating American miners. A natural sequence to a tariff would be that the Chinese would erect smelters here. He suggested a bounty of 3c. per pound to American producers, also 5c. to United States smelters, and removing all tariff duties.

DENVER, COLORADO

United States Tariff Commission Investigates Colorado Tungsten Industry.

The conference opened at Denver on June 17 and continued through four sessions, adjourning the next day. The Commission was represented by E. P. Costigan, chairman, and Guy C. Riddell, metallurgical expert for the U. S. Bureau of Mines. To prepare the way for effective progress at the sessions, the Commission had previously distributed questionnaires among the tungsten producers and millmen of the State. Of the several hundred sent out, there were received 75 replies. Failure to secure more was due to the fact that activities in the tungsten field during recent years have, in the majority, been conducted by prospectors and miners who, working in a small way, kept no records.



THE TUNGSTEN AREA OF COLORADO

The Commission had made it clear that, when desired by any operator, the reply would be held in confidence. Notwithstanding this privilege, the replies were all given in a generous disposition with no request for privacy. The data contained in these questionnaires will be the basis for the tabulation of valuable statistics.

Among the points the Commission desired to bring out specifically during the public session at Denver were the following:

What is the present condition of the tungsten industry in Colorado and what developments have transpired since the Tariff Act of October 3, 1913? To what extent can American deposits and production supply our domestic requirements? Due to war disturbances, what effects have been noted in the production of tungsten, in labor conditions, markets, and plant extensions? What are the costs of production in 1918 compared with those in 1913 and 1914? What can be set as a minimum price for tungsten ore at which American mining and reduction operations may be expected to show a reasonable profit? Are there any new treatment processes either in this country or abroad that may affect competitive American production?

Mr. Costigan's opening remarks made it clear to all present that the hearing was strictly informal in nature and that witnesses might express themselves in their own way and words, without oath, to the end of giving the Commission as much information as possible to assist it in arriving at a solution of the problem of stimulating mining of tungsten in this country. Feeling thus at ease, important statements were made and discussions were entered into by men representing every phase of the industry, not omitting the unionist side, represented by a miner from Boulder county. Among those taking part in the proceedings were: Warren F. Bleecker, manager of the Tungsten Products Co.; Nelson Franklin, manager of the Rare Metal Ores Co. and the Black Metal Mining Co.; I. N. Bair, lessee at the Good Friday mine, Boulder county; Edwin E. Chase, mining engineer of Denver; Frank Armstrong, Boulder engineer; Emerson J. Short, Denver attorney with tungsten mining interests; Robert M. Keeney, manager and metallurgist of the Ferro Alloys Co.; M. B. Tomblin, secretary of the Colorado Chapter American Mining Congress; W. B. Stoddard, manager of the Black Metal Reduction Co.; Frank E. Safely, lessee in mines; J. B. Finlay, president of the Colonial Steel Co.; George Rogers, owner of extensive valuable tungsten mining property in the Nederland district; John McKenna, president of the Vasco Mining Co.; and Harold Boericke, secretary-manager of the Primos Mining & Milling Company.

The Commission was presented with a printed statement on the condition of the tungsten mining industry in Boulder prepared by a committee of 12 representative men, including managers of large companies, lessees, small miners, and operators of concentration mills and reduction works. This statement is so comprehensive in its scope that very few points were left for the Commission's committee to bring out at the hearing. The sessions were therefore largely devoted to an enlargement of the vital points in this statement.

Boulder county is the only section of Colorado that has made any appreciable production of tungsten ores. Consequently almost all the witnesses represented interests in that county. Other data were given concerning small production in Gilpin, Park, Pitkin, Ouray, San Juan, Fremont, and Gunnison counties, but the prevailing opinion was that no development would be attempted in these districts unless the price for tungsten ore and concentrate shall materially advance. The belief was general, also, that prospecting in the Boulder county belt—now at a total standstill—will not be resumed until not only a favorable price for the commercial products shall be established, but until, through Federal means, such a price shall be stabilized.

The testimony presented proved that two companies, organized primarily to manufacture ferro-tungsten in Colorado, have discontinued such work entirely. These are the Boulder Tungsten Production Co. and the Ferro Alloys Co. The latter is now making ferro-chrome exclusively. The only firms that are meeting with success in the mining and milling of tungsten ores, with a single exception, are three companies that are subsidiary to strong steel companies in the East. These are the Vasco Mining Co., selling its concentrate to the Vanadium Alloys Steel Co.; the Primos Mining & Milling Co., whose product goes directly to the Primos Chemical Co.; and the Wolf Tongue Mining Co., having direct connection with the Firth-Stirling Steel Co. The exception mentioned is the Tungsten Products Co., which mines part of its ore, purchases custom ore, and manufactures ferro-tungsten and tungstic acid that is sold to various Eastern consumers.

In Boulder county most of the mining is done under the leasing system. There are no fixed rules regarding the terms upon which leasing is done. As shown by the testimony of Mr. Conklin, manager of the Vasco Mining Co., it is the practice of his company to render substantial assistance to its lessees whenever they are obliged to incur extra expense in the development or equipment of their blocks of ground. In all such instances, the company advances one-half of the cash necessary to continue the dead work. If success is attained, the company is reimbursed from the lessee's production; if failure follows, the company loses equally with the lessee. There is no uniformity in regard to royalties, every lease being gauged upon conditions. Royalties vary between 5 and 50% on mill returns.

Considerable discussion centred about the variable prices paid for ores of different grades. It has been common complaint among small miners that they are robbed by the purchasers of their ore; but the evidence presented at this hearing tended to prove that the millman does not make an exorbitant profit at any time, and frequently meets with losses. Figures of cost of concentrating low-grade tungsten were given by several mill operators. These figures differed considerably, the discrepancies being due, probably, to the different schemes used in the respective plants and to differences in capacity. The statement made by one was that it cost his company approximately $20 to concentrate one ton of 10% ore into 60% product.

According to testimony of well-informed witnesses, the quotations on tungsten concentrate as published in periodicals are always false, in every instance being considerably higher than such product commands in the market. Whereas, on June 15, the technical press gives a quotation of $19 to $24 per unit, it appears that transactions could not be made at such figures, but probably around $16 to $18.

The stabilizing in the market for ore and products was the keynote of all the remedies suggested for improving conditions in the American tungsten industry. It was thought that the Government should be able to establish an invariable price of from $30 to $40 per unit WO_3, based upon 60% product.

CRIPPLE CREEK, COLORADO

Half-Year's Dividends.—First-Aid Work.—Leasing Notes.—Drainage-Tunnel.

Dividends paid by Cripple Creek companies in the first half of the current year total $1,215,000, as follows: Cresson, $732,000 (6 monthly disbursements of $122,000 each); Golden Cycle, 6 monthly, $270,000; Portland, 2 quarterly, $180,000; and Granite, 2 bi-monthly, $33,000.

The U. S. Bureau of Mines safety-car No. 2 arrived here on June 16, to remain a month. Classes will be formed for first-aid and mine-rescue work.

A general leasing policy has been adopted by the Portland company, and all levels above No. 15 have been leased or are open for lease. By this method miners are obtainable, who would not otherwise work for wages.

The Komat Leasing Co., operating the Victor mine on Bull Cliffs, is unwatering the bottom or 14th level, at a depth of 1000 ft. No work has been done on this level for years.

Lessees at the Elkton produced 500 tons of 1-oz. ore in May.

The Acacia, with two sets of lessees, shipped 200 tons of $8 to $40 per ton.

The Roosevelt drainage-tunnel, due to labor shortage, was advanced only 49 ft. last month. The Portland drift at the tunnel-level was driven 252 ft. and the Cresson drift on the Funeral dike 212 ft. The flow from the tunnel has fallen to 3100 gal. per minute.

United Gold Mines production for May total 3000 tons, valued at $60,000 gross. The active properties of this company are the Trail mine and tunnel on Bull hill, W. P. H. on Ironclad hill, Bonanza on Battle mountain, and Wild Horse on Bull hill. All are operated under lease.

REPUBLIC, WASHINGTON

Recent Activities at Republic and in Okanogan County.

In the old Republic mine there is 45,000 to 50,000 tons of ore assaying from $4 to $6 per ton awaiting a cheap method of treatment. On the 200-ft. level two carloads of marketable ore is being broken monthly for shipment to smelters. The richer ore in the foot-wall is nearly exhausted.

In the Last Chance mine the Lone Pine-Surprise company is prospecting the hanging wall by diamond-drilling east beyond the main orebody on the 500-ft. level. This is being done because of stringers of quartz running off diagonally from the main body, rendering the hanging-wall area uncertain. Shipments total 1200 tons per month.

At the Knob Hill modern improvements indicate a belief in a future of the mine. The portal of the main adit has been concreted, and since the new shaft was sunk, a headframe, 50 ft. high, has been erected and equipped with an automatic device for tipping the bucket and delivering a ton of ore into a bin. From this the ore is delivered into a car of equal capacity and taken to a platform to be sorted and transferred to an ore-bin, whence it is delivered to railway cars for shipment. All material is automatically handled. The tracks are covered with sheds. New buildings have been erected for a blacksmith-shop, change-room, storeroom, powder-house, and sheds for the machinery. Mr. Daily is local manager, and Alexander McKay is superintendent. The drift from the new 200-ft. level is now under the old stopes, and the quality of the ore is improving.

In the Surprise mine six men are employed on two shifts driving north on the 300-ft. level, from a point north of the main incline shaft, into virgin ground. From the workings on the Clark adit 250 tons of ore is the weekly output.

Since the Consolidated Mining & Smelting Co. of Canada purchased the San Poil mine, considerable work has been done with diamond-drills for the purpose of proving the continuity of the vein on its pitch. The surface workings are under lease to John McKay, who is shipping ore.

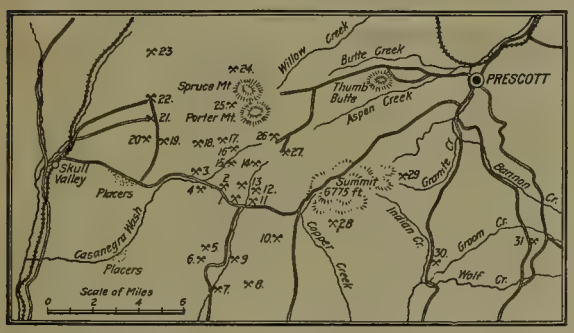
The American Flag mine at Sheridan, Okanogan county, near the Ferry County boundary line, is producing considerable ore, which assays from $10 to $200 per ton. About 200 tons has been mined and raised from development. The gangue is quartz, 7 to 15 ft. wide. A shaft has been sunk on it 100 ft., and a drift follows the hanging wall. Ore assaying up to $20 per ton carries from 80c. to $1.25 per ton gold, the remainder in silver. The nearest haul to the Spokane and British Columbia railway is eight miles, costing $3 per ton. The mine is owned by Maurice Snyder and Mr. Hoover.

The Nutria and Aztec mines, near Chesaw, in Okanogan county, on Copper mountain, owned by J. M. Lynch, has been bonded through Horace Smalley to Volney Williamson and associates of Spokane for $15,000, the bond to run 18 months from April 18. The first payment is due July 15. The product is magnetite, containing 2% copper. About 400 tons on the dump will be hauled by motor-truck to Mincaster, B. C., for shipment over the Great Northern railway to a smelter, where it will be mixed with Chewelah, (Stevens county) magnetite. The mine is opened by quarrying, breaking 100 tons per day. The Aztec adjoins the Nutria on the west. The ore contains a little more copper than the Nutria, and 4 oz. of silver per ton, and they both run in continuous deposits east and west up and across the mountain. The Aztec ore differs from the Nutria in that it is pyrrhotite.

THE MINING SUMMARY

ARIZONA

Copper Basin.—The centre of this district is 12 miles south-west of Prescott. Mining was started in 1879. A smelter was burned in 1893. Up to 1902 the field was dormant, when a revival set in. Since then there has been a good deal of work done. The accompanying map, re-drawn from 'Yavapai,' shows the principal mines. The Commercial is shipping 140 tons of ore daily. The Lucky 5 has 2600



MINES IN THE COPPER BASIN DISTRICT, ARIZONA, AS UNDER:

1. Commercial (Phelps-Dodge)
2. Copper Hill
3. U. S. Navy
4. Big Butte
5. Tri-Metallic
6. Mint
7. Lucky 5
8. War Eagle
9. Arizona Portland
10. Sink to Rise
11. Loma Prieta
12. Martin Schuber
13. Herman Boehm
14. Arizona Opal
15. Plymouth
16. Alto
17. Oregon
18. Robinson (Russell)
19. Gold Star
20. Jerome Prescott
21. Copper Valley
22. Logan
23. Martin
24. Derby
25. Queen
26. Zachariah
27. Thumb Butte Con.
28. Beard
29. Comet
30. Silver King
31. Ruth

tons on the dump. In the Loma Prieta is over 500,000 tons of 1.3% ore. Some of the mines are worked in a small way, others are awaiting buyers.

Oatman.—Gold production of United Eastern in May was 8290 tons averaging $22.44 per ton. During 17 months' operations, 125,000 tons of ore has assayed $22 per ton, of which 96% was extracted. Twelve dividends of 5c. each total $818,000.

Swansea.—The 500-ft. three-compartment shaft of the Swansea mines has been completed, and driving on the ore-body is in progress. A 200-ton mill is being erected.

Yuma.—The Red Cloud Consolidated Mines Co. is remodeling its mill. The mine should be a fair producer. About 30 men are employed.

CALIFORNIA

Happy Camp.—The manager, William Koerner, of the Gray Eagle copper mine, owned by the Mason Valley company of Nevada, reports that the company has completed development of the mine and is laying off its men, who have averaged 70 during the past two years. Lack of transportation is the cause, and the next move is the construction of a railway or other facilities into the district. Chrome development is active in this district. Seven rich discoveries have been recorded during the past week.

Ingot.—The Afterthought Copper Co, as already mentioned in these columns, has closed its plant here, and will as soon as possible construct an electrolytic zinc plant, and a reverberatory-furnace for the copper concentrate. It was found that payment for freight, trucking to rail, treatment charges on concentrate, and metallurgical losses were more than $150,000 per month. This can be saved by local treatment.

Oroville.—The Western Ore Co. has shipped its first carload of chrome concentrate. The mill is producing 12 tons of this product daily. The deposits are at Limestone, on the Oroville-Paradise road.

Tuolumne.—This old mining town in Tuolumne county was mostly destroyed by fire on June 17.

COLORADO

Creede.—Silver-gold ore shipments from this district are nearly 150 tons daily. The Creede Exploration Co. supplies about half of this. The Equity Creede company has uncovered 33 oz. silver and $3 gold ore on a lower level.

Denver.—The U. S. Tariff Commission met here on the 17th to discuss the tungsten situation. It was argued by producers that the ore is being mined at a loss, even at $22 per unit. An increase in price was suggested and a tariff on imports.

Dumont.—B. C. West has lately taken over the old La Maynan group of eight claims. He will hurry development and take out shipping ore. The main tunnel is in 1200 ft. on a vein 6 to 25 ft. wide, high in lead and silver. The most noted property at Dumont is the Albro, under lease and bond for two years to Mrs. Dingle and son. They are shipping high-grade copper and silver ore regularly to the Globe smelter at Denver.——The amalgamation and concentration mill of C. Lirschen at Dumont is in commission only about half time, then only with 15 of the 30 stamps. The main reason is that wages are so high at the copper centres of Montana and Arizona that few first-class miners are left in Colorado. This mill is complete, and the owner states that he could easily mine and treat 100 tons per day if he could get men. The ore carries silver, gold, and copper.

Lawson.—The mill of the Little Giant M. & M. Co. and T. & T. Co. is now in operation. It is equipped with Blake crusher, ball and tube-mills, and three concentrating tables, and a 6-cell flotation plant. The mine has been extensively developed. Mrs. Etta Myneer is manager and R. B. Martin is superintendent.

Ophir.—The New Dominion has installed an air-compressor, drills, and milling machinery.

Freighting outfits are getting ready to move the season's output of carnotite ore, from Paradox Valley and nearby fields. The Standard Chemical Co. at Naturita is shipping 20 truck-loads of carnotite daily. A large number of men are employed.

The Mount Blaine Oil Shale Co. is having a still constructed at Denver. In order to test it before it is shipped to the mine. Three tons of shale has been sent to Denver.

The Butterfly mine will start milling as soon as a good head of water is available. A large amount of ore is ready.

The Ophir Loop Mines Co. has leased the Silver Bell mine and a shipment has been made by the new lessees.

The San Bernardo mine at Matterhorn bids fair to be-

come one of the main producers of the district, as it has shipped two cars of ore.

Manganese claim-owners here are interested in processes for dressing low-grade ore.

The Carbonero is shipping crude ore in large quantities.

Ouray.—The Ouray Smelting & Refining Co. has made several changes in its mill below the town. The Messberg flotation unit has been removed, and a Hyde machine put in its place. An addition is a Deister slime-table. The laboratory is now available for testing the various ores of the district. It is well fitted with a baby Wilfley flotation machine, three sets of flotation experiment machines, and full sets of sizers. T. B. Crawford is manager for the company. Ore from the Gem, Calliope, Float, and Wedge mines will be milled, and a special effort made to reduce the silica content, so as to put out a high-grade shipping product.

Red Mountain.—The Red Mountain district is still covered with a heavy blanket of snow, and rail transportation remains at a standstill.

The Summit Copper Mining & Milling Co. has a large number of men working on the old San Antonia claims. At present they are putting up a raise to open a large body of ore. Large shipments will start as soon as the Red Mountain line is open.

Telluride.—The Alta mine suffered a loss of $10,000 when a fire, starting in the stables, extended to the blacksmith shop, compressor-house, tramway terminal, and snow-sheds. All buildings and contents were lost. The compressor was ruined, and four mules in the stable were burned. It is believed that the fire was caused by a similar accident as that at the Tomboy, when its new bunk-house was burned. In this case a lighted carbide lamp had been left blazing against the wall of the bunk-house, and at the Alta the opinion is that either a lantern or a candle was left burning in the stables. When the terminal burned down, the entire tramway, ¾ mile long, collapsed, but the towers were not broken, and repairs can be made easily. Notwithstanding the loss sustained, and the handicap to development, the Alta will continue to operate.

During May the Tomboy shipped 45 cars of iron concentrate, and the Smuggler 68 cars of iron and flotation concentrates.

IDAHO

Gilmore.—The Pittsburg-Idaho Co. in Lemhi county has issued a brief report for 1917. Cash receipts from ore shipped totaled $199,060. Operations cost $247,208, making a loss of $48,148. Dividends absorbed $65,524, so the balance of $182,409 from 1916 was reduced to $68,738. Current assets amount to $47,465, and liabilities $91,187. Causes of the loss were delay in delivery in power machinery, water in the mine, and transportation difficulties. On May 1, 1918, the outlook is better, as the power-plant is working, sinking to 700 ft. is under way, and silver is $1 per ounce.

Kellogg.—The Pine Creek branch, 9.3 miles long, of the O.-W. R. & N. Co. is to be completed at once. This will result in large ore shipments from the Constitution, Highland-Surprise, Douglas, and Nabob mines; but at least 12 mines will benefit therefrom.

On July 5 the Caledonia Mining Co. pays 3c. per share, equal to $78,150.

Mullan.—A 150-ton plant is being erected by C. L. Hewitt at the Nine Mile mill to concentrate 60,000 tons of coarse tailing, 20 years old, from the Tamarack & Custer and Rex mines. The average content is 6% lead and 9% zinc. Jigs, tables, and flotation cells will be used.

Porthill.—The Idaho-Continental has accumulated 1400 tons of $100 lead-silver concentrate in 50 days. This is to be hauled by truck 26 miles to Porthill for shipment to smelters.

Wallace.—Reports from Spokane state that shares in the Hypotheek M. & M. Co. jumped from 4 to 22 cents within two months, and the local Stock Exchange is making an investigation. An option had been given on 1,100,000 of the 2,000,000 shares to New York people, at 15c. a share. After this the price bounded up.

MICHIGAN

Houghton.—Calumet & Hecla reports as follows:

Mines	Copper in May, pounds	Five months, pounds
Ahmeek	2,516,660	11,674,353
Allouez	715,427	3,353,637
Calumet & Hecla	6,008,589	31,105,504
Centennial	213,848	1,096,785
Isle Royale	1,395,242	5,861,931
La Salle	201,117	875,395
Osceola	1,485,563	6,794,897
Superior	140,944	842,199
White Pine	267,342	1,166,940

MISSOURI

Joplin.—Production of the region last week amounted to 6555 tons of blende, 298 tons of calamine, and 1172 tons of lead. Prices averaged $52, $30, and $87 per ton, respectively. Total value was $452,254, making $11,194,168 for 24 weeks. Missouri contributed $98,572.

There is a shortage of underground men in the district, especially shovelers.

The 250-ton (per shift) mill of the Grayson M. & M. Co., 5 miles south-west, is nearly complete. H. H. Hughes is in charge.

Sarcoxie.—The Flannery Zinc Co. is putting in a 75-hp. Diesel engine and duplex-plunger pump to drain its mine. This is a new arrangement for this field.

MONTANA

Giltedge.—A new cyanide mill has been completed and will be operated by E. B. Coolidge of Maiden and his Lewistown associates. It is intended to first treat old tailing that assay $1.90 gold per ton. Later it is hoped that much low-grade ore that is exposed can be worked at a profit.

The Mammoth mine and mill has been overhauled and will be operated this summer by N. J. Littlejohn of Lewistown.

Grass Range.—The Ford Creek Oil Co.'s well is down 700 ft. Drilling is being continued. A small flow of gas has been ecountered.

Lehigh.—No. 2 mine of the Cottonwood Coal Co. is now producing. This is a drift mine, consequently expenses are low. Lehigh is now producing 1000 tons of coal per day, mostly consumed by the Great Northern Railway.

Lewistown.—The Hanover plant of the Three Forks Portland Cement Co. is completed and has started to make cement. The rated output is about 25,000 bbl. per month. Gypsum wall-plaster is also made by the company.

The well of the Judith Oil Co., 12 miles east of Lewistown, is down 700 ft. A strong flow of water has interfered with progress, and the well may be abandoned.

Winifred.—Drilling has been started by the Kansas Montana Oil Co. with a standard rig a few miles north-east of town. The Home Oil Co. has also purchased a rig and expects to start drilling soon. The oil-sands lie 2000 ft. deep, and the structures have been reported on favorably by several prominent geologists.

NEVADA

Dayton.—The Como Consolidated Mining Co., which is operating 10 miles from here and 14 miles south-east of Virginia City, has made its first clean-up. From 1400 tons of ore in 20 days, gold worth $5987 was sold and $5000 is

absorbed in the cyanide plant. Future monthly yields are estimated at $25,000, of which $15,000 will be profit. The mine is opened to a depth of 360 ft. The mine is fully equipped, including electric power and 90-ton mill.

Tonopah.—Production of some of the local mines in May are as under:

Mine	Tons	Silver, oz.	Gold, oz.	Profit
Belmont	9,320	119,671	1,222	$66,011
Tonopah	15,235	121,950	1,190	53,950
Jim Butler....	2,160	.....	....	41,552

Tybo.—The first 100-ton unit of the Louisiana Consolidated company's mill, 65 miles north-east of Tonopah, is working. Concentrate is said to assay 50% lead, 80 oz. silver, and $20 gold per ton. Five tons of $100 lead ore is also being mined daily.

OKLAHOMA

Douthat.—Twenty drills are busy south and east of this place, in an area hitherto disregarded.

Picher.—Oklahoma mines produced 5086 tons of blende and 947 tons of lead last week, valued at $337,862.

SOUTH DAKOTA

Deadwood.—Work has been resumed at the Echo property in the Maitland district. A power-line has been extended to the mine and the shaft will be continued to a depth of 500 ft. Equipment includes a hoist and compressor.

The Cutting company has made arrangements to install a hoist and sink 500 ft. The gold-silver ore has been developed by tunnels. It is intended to sink and then drive laterals. The ground adjoins the Homestake on the west.

Lead.—The Bismarck mill at Flatiron has been placed in commission with a daily capacity of 40 to 50 tons. This will be increased to 100 tons as soon as the mine warrants it. The ore contains gold and silver, and is said to be of good milling grade. In addition, tungsten ore is found on the property.

Roubaix.—The Custer Peake Copper Co. will resume work. The shaft will be deepened to 500 ft. In addition, the company will purchase the Jungle mine adjoining, on which copper ore has been opened. The concentrator will be re-modeled.

Tinton.—After an idleness of nearly ten years work has been started at the Tinton company's property in the Nigger Hill district. Development shows a large deposit of low-grade tin. The property is equipped with a concentrator, which will be repaired. It is expected that the ore can be handled at a profit.

UTAH

Alta.—The Alta Tunnel & Transportation Co.'s tunnel is in 3408 ft., with 142 ft. to go to cut the Prince of Wales fissure. The face is 1140 ft. below the outcrop. Lead-silver seams are being cut by the tunnel at present.

Dugway.—About 30 miners are employed in this district at present. Several developments are said to have been good. Ore contains lead, copper, and silver.

Garfield.—Employees (500 of the 1600) at the A. S. & R. smelter here have decided to demand a flat raise of $1 per day. Wages vary from $3.15 to $6.65 per 8-hr. day.

Park City.—On July 1 the Judge M. & S. Co. pays 12½c. per share, equal to $60,000. This makes $120,000 for the current year and $2,190,000 to date.

Tintic.—Chief Consolidated is to start diamond-drilling in the northern and eastern sections of its property. H. E. Horn is in charge of the new exploration work.

WASHINGTON

Leadpoint.—The Lead Trust mine near here has been acquired by a syndicate of Grant county men, who are to spend $40,000 in new machinery, including a mill. F. J. Barrett of Ephrata is largely interested, also J. C. Callahan, who may become superintendent.

Northport.—The Electric Point company has opened ore at a depth of 800 ft. Reserves are between 60,000 and 80,000 tons. A survey is to be made for construction of a railroad to connect the lower terminal of the aerial tram at Leadpoint with the Great Northern line at New Boundary. The distance is 10 miles, and the line may cost $150,000.

At the annual meeting of the Northport Smelting & Refining Co., J. J. Day was re-elected president, E. Boyce, vice-president, and E. R. Day, secretary-treasurer. The Hercules and Tamarack & Custer companies of Idaho are the largest shareholders in the smelter.

CANADA

British Columbia

Hedley.—The Hedley Gold Mining Co. pays 15c. per share on June 29.

Quesnel Forks.—The Ward-Hopp suit, which has been engaging the attention of the Legislature and the Courts of British Columbia for years and which is familiar to Canadian mining men, has assumed a new phase. In a recent judgment, the Court of Appeals of the Province found in favor of the plaintiffs—R. T. Ward and his associates—thus reversing the decision of Justice W. A. Macdonald, in the lower Court, whose verdict was that the placer-mining leases (the Bullion mines at Quesnel Forks) in dispute were properly the property of the defendant, John Hopp et al. It is expected that the case will be appealed by the latter, possibly going to the Supreme Court of Canada, and thence to the Privy Council of the Empire. The dispute is a long one, but includes such phases as concentration of work, lease rights, staking supposedly-abandoned ground, injunctions against working, re-staking, and forfeiture.

General interest in platinum has been aroused among local prospectors. The metal occurs associated with placer gold in this region. John Hobson, when operating the Bullion Hydraulic Gold Mining Co., recovered a small quantity each year. The discovery of its source is one of the matters which, it is believed, will be investigated by a party consisting of J. B. Tyrrell, Robert A. Bryce, and Gordon Taylor. Regarding platinum in the Cariboo it is interesting to quote William Fleet Robertson, Provincial Mineralogist, in his annual report for 1902, when he said: "I found that there were very small quantities of platinum in the Fraser River bars. I traced this up to Quesnel, where the Quesnel river enters the Fraser, above which point I could find but little in the Fraser river, as it chiefly seemed to be brought in by the Quesnel, which was traced up to Horsefly." He adds that he knows of no platinum occurring in place in Cariboo, but that British Columbia has platinum occurring with placer gold in Dease Lake, Cassiar, in considerable quantities and also in the Tulameen district, in which latter district it also has been found in place.

Mining men and the public generally in some sections of the British Columbian interior are agitating for some celebration of the 60th anniversary of the discovery of gold in the Cariboo district and the building of the famous Cariboo road. The movement started at Clinton, and is being met with favor, it being felt that something should be done to mark and commemorate an event of so much importance and interest as to merit a few pages in Canadian history, particularly in the mining development of Western Canada.

Trail.—The Consolidated M. & S. Co.'s reduction works here now employs 1100 men, who receive $130,000 monthly. Ore smelted amounts to over 4400 tons per week.

Ontario

Cobalt.—During May the Nipissing extracted silver worth $338,347 from 195 tons of high and 7306 tons of low-grade

ore. Including custom metal, there was shipped 538,231 oz. Development at No. 73 shaft was favorable, several new veins being found. They are not wide, but one is from 2 to 4 in., assaying between 2000 and 3000 oz. per ton. The Nipissing output for five months is $400,000 ahead of the same period of 1917.

Fort Matachewan.—A complete report on this district has been prepared by A. G. Burrows of the Bureau of Mines. It is considered disappointing.

It is said that the Mining Corporation of Canada is negotiating for purchase of the Davidson mine. This company has secured an option on the water-power in the district, amounting to 2000 horse-power.

A diamond-drill is at work on the Colorado Ontario property (Otisse) in this district. Twenty men are employed at this mine.

There is promise of considerable activity here this season. Gold claims staked number close to one thousand, upon which certain work must be done. Confusion exists between some old and new holdings, due to conflicting staking. The Otisse and Davidson groups may be consolidated. Machinery is being hauled to the former.

Porcupine.—Hollinger Consolidated paid 1%, equal to $246,000, on June 17. This is the first distribution for 15 months.

McIntyre-Porcupine produced gold worth $430,000 during the first quarter of 1918. A dividend of 5%, equal to $180,000, was paid on June 15.

KOREA

Seoul.—In Mosan district of northern Chosen a deposit of iron ore has been discovered, estimated to contain 200,000,000 tons. The Mitsubishi company controls most of it. Country is rough, and recent completion of a railway nearby will aid development.

Unsan.—Recent returns from the Oriental Consolidated are as follows:

Month	Tons	Gold yield	Net profit
February	22,730	$123,813	$46,038
March	25,830	128,754	47,950
April	24,067	130,405	.....
May	....	134,000	.....

The Maibong tube-mill plant extracted 95.4% and the Taracol cyanide plant 87.3%.

MEXICO

Baja California

The well-known deposit of manganese on the coast of Lower California, near the town of Mulegé, opposite the port of Guaymas, have been turned over to Enrique Breceda under a so-called 'provisional permit,' being in effect an exclusive concession for a period of six months, counting from February 26 last. The details of the concession are published in the official organ of the Department of Mines, called the 'Boletin Minero,' Vol. 5, No. 2, recently issued. The concessionaire is required to produce not less than 200 tons monthly of manganese ore, and is obliged to pay a royalty of ₱3 per ton (metric) to the Government, plus 50 centavos per ton to cover the costs of official inspection. The mining rights relate only to the residual accumulations over the veins and to detrital deposits at lower levels, at places known as Point Concepción, Point Aguja, and Trinidad, all in the municipality of Mulegé. The total output under the concession is limited to 6000 metric tons.

Chihuahua

Cuidad Juarez.—A recent U. S. Consular Report states that there has lately been organized here a company under the name of Oficina General Ensayes to conduct an assay-office and chemical laboratory. Modern apparatus has been installed, the establishment being said to be the largest and best equipped in northern Chihuahua. The machinery was mostly purchased in the United States.

PERSONAL

Note: The Editor invites members of the profession to send particulars of their work and appointments. This information is interesting to our readers.

Albert Sauveur is in Paris.

W. F. Ferrier is at Ottawa.

Tyson S. Dines, of Denver, is here.

A. G. McGregor is at Jerome, Arizona.

James C. Ray is Captain in the 603rd Pioneer Regiment.

Robert H. Burrage is Lieutenant in the 27th Engineers.

Harold P. Taylor, of Douglas, Arizona, was here during the week.

Donald M. Liddell is Captain, with the Aircraft Board, New York.

G. L. Sheldon returns to Ely, Nevada, from Montana, early in July.

Kenzo Ikeda, with Fujita & Co., Osaka, is on his way back to Japan.

R. J. Glendinning, of Salt Lake City, was in San Francisco this week.

D. J. Argall has left Juneau temporarily and is now at La Jolla, California.

Simonds & Burns, mining engineers of New York, have dissolved partnership.

Scott Turner, Lieutenant in the Naval Reserve, is stationed at Cleveland, Ohio.

Charles W. Wright is Captain in charge for the American Red Cross in Sardinia, Italy.

R. S. Ammen, of the Cayuse Gulch mine, in Siskiyou county, is visiting San Francisco.

William J. Hayes is mining engineer to the Compañía Minera Choco-Pacifico, at Andagoya, in Colombia.

W. G. Miller, Provincial Geologist of Ontario, has gone to London to represent Canada on the Advisory Board of the Imperial Mineral Resources Bureau.

Melville F. Coolbaugh, professor of chemistry at the Colorado School of Mines, has gone to Washington, where he will serve as chemist for the Government.

Charles S. Vadner has gone from Reno, Nevada, to Tucson, Arizona, where he will be engaged in research work on manganese for the U. S. Bureau of Mines.

William Wraith, general manager for the International Smelting & Refining Co., returned to Salt Lake City on June 15 after an absence of several months in South America.

C. L. Berrien, assistant general superintendent of mines to the Anaconda Copper Mining Co., has received a commission as Major in the engineer department of the Army and expects to leave for France soon.

Roger Taylor has been appointed to the Ordnance Reserve Corps, and is therefore severing his connections with the engineering firm of Frederic DeP. Hone & Co., of which he has been a member for 2½ years.

James Douglas died at New York on June 25, at the age of 81. Further reference to this deeply regrettable event will be made in due course.

Frederick B. Reece died of wounds received in action on April 20 in France, where he was serving in the Royal Flying Corps, although he first joined the Artillery in the early part of 1915, being promoted to Captain. He was a graduate of the University of California, although an Englishman by birth. The article on 'Oils Used in the Flotation Process,' appearing in our issue of May 1, 1915, was written by him in London just before he received his commission. He was a young engineer of high character and much promise, which he fulfilled by giving his life for his country at the front of battle.

THE METAL MARKET



METAL PRICES

San Francisco, June 25

Aluminum-dust, large and small lots, cents per lb.	65—70
Antimony (wholesale), cents per pound	15
Copper, electrolytic, cents per pound, in carload lots	23½
Copper, electrolytic, cents per pound, in small quantities	24⅝
Lead, pig, cents per pound	8.07½—9.07½
Platinum, Government price, per ounce	$105
Quicksilver, per flask of 75 lb.	$110
Spelter, cents per pound	9¾
Zinc-dust, cents per pound	17½

Antimony, as discussed on June 24 before the U. S. Tariff Commission, will be found on page 899 of this issue.

ORE PRICES

June 25

Antimony, 45% metal, f.o.b. California, per unit	$1.10
Chrome, 38 to 48%, California, per unit	$1.25—$1.50
Magnesite, crude, California, per ton (nominal price)	$7.00—$8.00
Manganese, domestic, 35 to 54%, f.o.b. South Chicago, per unit (Government price, effective May 29)	$0.86—$1.30
Manganese, domestic, 35 to 54%, f.o.b. east of South Chicago, per unit (Government price, effective May 29)	$1.01—$1.45
(Manganese, domestic, penalty of 50c. to $1 per ton for 8% and up to 25% silica, and bonus of 50c. to $1 for less than 8 and 5%.)	
Molybdenite, per lb., 90% MoS_2	$1.25
Pyrite, per unit of sulphur, cents	28
Tungsten, 60% WO_3, California, per unit	$24

..Imports of chrome are to be restricted, according to an order of the War Trade Board, dated June 13. To provide for current demand, pending development of domestic deposits, imports from Cuba, Guatemala, Newfoundland, and Brazil will be permitted, not exceeding 45,000 tons up to March 31, 1919; and from New Caledonia up to 10,000 tons prior to December 31, 1918. Shipments overland from Canada (or by lake), and Mexico, or as return cargo from Europe, will be allowed under certain conditions of loading. Licenses for import of chrome from overseas have been revoked as to shipments made after June 15, 1918.

Import licenses for gypsum from overseas have also been revoked on and after June 11, except on sailing vessels or barges.

EASTERN METAL MARKET

(By wire from New York)

June 25.—Copper is unchanged. Lead is quiet, though firm. Spelter is strong and higher.

SILVER

Below are given official (not Government) quotations, in cents per ounce of silver 999 fine. In order to make prompt settlements with smelters and brokers, producers allow a discount from the Government price of $1, hence the lower price. The Government has not fixed the general market price at $1, but will pay this price (as from April 23, 1918) for all silver purchased by it. The equivalent of dollar silver (1000 fine) in British currency is 46.65 pence per ounce (925 fine), calculated at the current rate of exchange.

Date	New York, cents	London, pence
June 19	99.50	48.87
" 20	99.50	48.87
" 21	99.50	48.87
" 22	99.50	48.87
" 23 Sunday		
" 24	99.50	48.87
" 25	99.50	48.87

Average week ending	
May 14	99.50
" 21	99.50
" 28	99.50
June 4	99.50
" 11	99.50
" 18	99.50
" 25	99.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	56.76	75.14	88.72	July	63.06	78.92	....
Feb.	56.74	77.54	85.79	Aug.	66.07	85.40	....
Mch.	57.89	74.13	88.11	Sept.	68.51	100.73	....
Apr.	64.37	72.51	95.35	Oct.	67.86	87.38	....
May	74.27	74.61	99.50	Nov.	71.60	85.97	....
June	65.04	76.44	....	Dec.	75.70	85.97	....

COPPER

On September 21, 1917, the Government fixed copper prices at 23.50c. per lb. for large lots, and 24.67½c. for small lots, effective until June 1, 1918. On this date the prices were re-fixed until August 15, 1918. Quotations in cents per pound are as under:

Date	
June 19	23.50
" 20	23.50
" 21	23.50
" 22	23.50
" 23 Sunday	
" 24	23.50
" 25	23.50

Average week ending	
May 14	23.50
" 21	23.50
" 28	23.50
June 4	23.50
" 11	23.50
" 18	23.50
" 25	23.50

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	24.30	29.53	23.50	July	25.66	29.67	....
Feb.	26.62	34.57	23.50	Aug.	27.03	27.42	....
Mch.	26.65	36.00	23.50	Sept.	28.28	25.11	....
Apr.	28.02	33.16	23.50	Oct.	28.50	23.50	....
May	29.02	31.69	23.50	Nov.	31.95	23.50	....
June	27.47	32.57	....	Dec.	32.89	23.50	....

A probable early revision of copper prices is announced from the East. Import licenses for copper ore from overseas, save from Cuba, have been revoked by the War Trade Board, except for shipments made prior to June 10. The reason for this is to bring about the import of matte instead of the bulkier crude ore.

LEAD

Lead is quoted in cents per pound, New York delivery. Government metal receives 7c. per lb. until August 6.

Date	
June 19	7.82
" 20	7.82
" 21	7.82
" 22	7.82
" 23 Sunday	
" 24	7.82
" 25	7.82

Average week ending	
May 14	6.73
" 21	6.92
" 28	7.07
June 4	7.16
" 11	7.31
" 18	7.61
" 25	7.82

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	5.95	7.04	6.85	July	6.40	10.93	....
Feb.	6.23	9.10	7.07	Aug.	6.28	10.76	....
Mch.	7.26	10.07	7.26	Sept.	6.86	9.07	....
Apr.	7.70	9.38	6.99	Oct.	7.02	6.97	....
May	7.38	10.29	6.88	Nov.	7.07	6.38	....
June	6.88	11.74	....	Dec.	7.55	6.49	....

ZINC

Zinc is quoted as spelter, standard Western brands, New York delivery, in cents per pound. On May 25, 1918, the Government fixed prices until September for grade A spelter at 12c. per lb. for itself and the open market. Lower grades can make their own prices as usual. Sheet-zinc is fixed at 15c., and plate at 14c. per pound.

Date	
June 19	7.87
" 20	8.00
" 21	8.12
" 22	8.25
" 23 Sunday	
" 24	8.37
" 25	8.50

Average week ending	
May 14	7.21
" 21	7.41
" 28	7.50
June 4	7.50
" 11	7.56
" 18	7.70
" 25	8.18

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	18.21	9.75	7.87	July	9.90	8.98	....
Feb.	19.99	10.45	7.97	Aug.	9.03	8.58	....
Mch.	18.40	10.78	7.67	Sept.	9.18	8.33	....
Apr.	18.62	10.20	7.04	Oct.	9.92	8.32	....
May	16.01	9.41	7.29	Nov.	11.81	7.76	....
June	12.85	9.63	....	Dec.	11.26	7.84	....

Zinc ore was $2.50 per ton stronger at Joplin, Missouri, last week. Average sales were $52 per ton, but the range was from $40 to $55.

C. E. Siebenthal, of the U. S. Geological Survey, suggests suspending production of prime Western spelter until the surplus is exhausted.

With reference to the Canadian zinc bounty, this applies only up to 8c. per lb., that is, if a 2c. bounty sends the price received above that amount, it is reduced or entirely eliminated. The object is to ensure as far as possible a price of 8c. per pound.

QUICKSILVER

The primary market for quicksilver is San Francisco, California being the largest producer. The price is fixed in the open market, according to quantity. The Government is taking 40% of the United States quicksilver output, paying therefor $105 per flask. Outside of this business the competitive market can make any price as usual. Prices, in dollars per flask of 75 pounds:

Date	
May 28	110.00
June 4	110.00
" 11	110.00
" 18	110.00
" 25	110.00

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	222.00	81.00	128.06	July	81.20	102.00	....
Feb.	295.00	126.25	118.00	Aug.	74.50	115.00	....
Mch.	219.00	113.75	112.00	Sept.	75.00	112.00	....
Apr.	141.60	114.50	115.00	Oct.	78.20	102.00	....
May	90.00	104.00	110.00	Nov.	79.50	102.50	....
June	74.70	85.50	....	Dec.	80.00	117.42	....

TIN

Prices in New York, in cents per pound. These prices are nominal.

Monthly averages

	1916	1917	1918		1916	1917	1918
Jan.	41.76	44.10	85.13	July	38.37	62.60	....
Feb.	42.60	51.47	85.00	Aug.	38.88	62.53	....
Mch.	50.50	54.27	85.00	Sept.	36.66	61.54	....
Apr.	51.49	55.63	88.53	Oct.	41.10	62.24	....
May	49.10	63.21	100.01	Nov.	44.12	74.18	....
June	42.07	61.93	....	Dec.	42.55	85.00	....

ORES

Antimony: There have been no developments.

Manganese Alloys: Ferro-manganese is quiet, most consumers being well covered by recent large purchases. Domestic alloy is held at $250, delivered, for 70% material plus $4 per unit above this standard. Spiegeleisen is quiet and unchanged at $75 furnace for 16% alloy, plus $3.50 per unit above this standard.

Molybdenum: The market is unchanged. Inquiry, outside of some for export, is light.

Tungsten: Quotations are nominally unchanged. Demand is small, consumers being well covered, apparently.

The Cassel Cyanide Co. of Glasgow paid an interim dividend of 1s. (24 cents) on June 1. On the 705,000 shares issued this amounts to $169,200. Distributions have been made since 1891.

Eastern Metal Market

New York, June 19.

None of the markets is characterized by special activity so far as the volume of sales is concerned, but all except tin and copper are strong and higher.

Conditions on the surface appear unchanged in copper, but dissatisfaction prevails as to prices and costs.

Tin continues to ease slightly and sales have been in small volume.

Lead is scarce but has advanced decidedly.

Zinc is strong and higher on restricted offerings.

Antimony has advanced, and is in fair demand.

The steel-price schedule for the period commencing July 1 will be discussed at Washington June 21 between the War Industries Board and the iron and steel manufacturers' committee. A preliminary meeting of the latter is being held today in New York. Costs in the next quarter will be higher, the freight advances adding $1 to $1.50 to the cost of pig-iron, says 'The Iron Age.' The coming price-conference is plainly dwarfed by the changes involved in the new Government control of iron and steel distribution, which will probably be more radical than the trade was willing to believe. Cabled orders from American headquarters in France in the past week call for a staggering amount of steel, including hundreds of locomotives and many thousands of cars. The Railroad Administration is also planning to buy 400 more locomotives and to increase by 40% the order for 100,000 freight cars already placed.

COPPER

The question of an upward revision in the copper price of 23.50c. continues to be an absorbing topic and it is evident that producers are by no means satisfied with the present status. A meeting of the leading producers was held in New York yesterday, but the object has not been given out. What is regarded as a significant fact is that as yet the President has not officially announced the re-establishment of the present price as effective from June 1 to August 15, although the War Industries Board has so recommended. An argument now being used is that the freight advance is to cause an increase in costs of at least 1c. per lb. Many believe a readjustment is yet possible, either by August 15 or before. The demand is strong and consumption is on a large scale. Refinery output in May was larger than that in April and the monthly average is now said to be about equal to that of 1917. It is asserted, but not confirmed, that not less than 90% of the present output is being absorbed by the United States and its Allies. Imports of copepr have been 91,000 tons to May 1 this year, as contrasted with 85,000 tons to May 1, 1917.

TIN

The tin market continues to ease, so far as may be judged from its extreme dullness and inactivity. There has been very little doing the past week. A fair inquiry for off-grades has been evident, and some business in this description has been done, in fact, more of such tin could have been sold had it been offered. Only light sales have been made in future shipments from the Far East. These sales were for July and August shipment, with some for September, all at about 80 to 81c. per lb., as compared with 82c. a week ago. Arrivals at Atlantic ports, up to June 14 inclusive, have been 465 tons, while those at Pacific ports to June 15 inclusive, have been about 2490 tons, as reported by the New York Metal Exchange. So much more tin is coming direct via Pacific ports that arrivals there are more important than formerly, and are being prominently and daily reported. It is estimated that about 5000 tons is afloat from Eastern ports. The London market has not changed since last week, spot Straits having been quoted yesterday at £329 per ton.

LEAD

The market for lead continues strong, but was made decidedly stronger on Monday by the advance of the American Smelting & Refining Co. in its quotation from 7.25c., New York, to 7.82½c. This represents an increase of $11.50 per ton, or 57½ points, and is quite unusual. It was the cause of considerable surprise. The market is therefore quotable at 7.75c., St. Louis, or 7.82½c., New York, but is more or less nominal, the metal being rather scarce. The same feature that has been prominent in this market for some weeks continues, namely, restricted supplies for prompt June and July shipment. Buyers have been desirous of obtaining as much lead as possible before the advance in freight rates becomes effective, and this has been one strong factor in the advancing market. Imports of lead in April were 6720 gross tons, making the total, for the first four months of this year, 32,315 tons, against 16,147 tons for the same four months of 1917. Exports were 6925 tons, as against 8669 tons in April 1917.

ZINC

Many believe that the zinc industry has passed through its period of illness, that it is now convalescing, and that it has nearly, or soon will attain robust health again. It is certain that it is becoming stronger daily. Yesterday as high as 7.75 to 7.87½c. was bid for prime Western for early delivery, and 7.87½c. was offered for July shipment. Few dealers are quoting less than 7.75c., St. Louis, or 8c., New York, for early delivery, and this may be regarded as the market. For third quarter 8c. is quoted, St. Louis, or 8.25c., New York. Sales have been made of one or two small lots at 7.75c., St. Louis, for June and early July shipment, but, for the most part, offerings are meagre for any position. Some predict that prime Western will soon sell at 8c., St. Louis, or 8.25c., New York. The entire situation is decidedly strong and eminently satisfactory. The feature of news of the week has been the suggestion from C. E. Siebenthal of the U. S. Geological Survey, that certain Western producers shut-down for two or three months, allow their men to assist Western farmers in the harvesting of crops, and thus cut down the production of grades C and D zinc. In this way it is believed that the market price of these might then more nearly approach a relative parity with that of grade A. The proposition, while surprising and unusual, is not regarded seriously, nor is it likely to be acted upon. Exports this year have been much less than those in 1917. To May 1, 1918, the total has been 33,158 gross tons, against 71,244 tons to May 1, 1917.

ANTIMONY

The market is stronger at 13.25c., New York, duty paid, for Chinese and Japanese grades, for prompt and early delivery. This is due to the recent fairly large sales and to the greater interest on the part of consumers who desire to purchase before the freight rates advance the price.

ALUMINUM

For No. 1 virgin metal, 98 to 99% pure, the Government maximum price is 33c. per lb. for 50-ton lots, 33.10c. per lb. for 15 to 50 tons, and 33.20c. per lb. for 1 to 15 tons. The same prices rule for scrap aluminum.

Production of ferro-manganese in the United States in May, by blast and electric furnaces, was 35,790 tons, a record. The spiegeleisen output was 17,844 tons.

Book Reviews

Chemical Analysis of Iron. By A. A. Blair. 8th edition. Pp. 318, ill., index. J. B. Lippincott Co., Philadelphia, 1918. For sale by 'Mining and Scientific Press.' Price, $4.

Since 1912, when the last edition appeared, there have been many improvements in the analysis of iron ore, limestone, coal, coke, clay, sand, iron, steel, and alloy metals. Since 1914, steel and alloy metals have become highly important, and a handbook containing up-to-date methods of analysis is welcome. In the handling of 60,000,000 tons of iron ore, manufacture of 35,000,000 tons of steel, and hundreds of thousand tons of alloy steels in a year in this country, it might be said that the whole business is based on careful analyses, which must be performed rapidly. The first 54 pages of the new book describes the apparatus and reagents used in determinations; the remainder is devoted to methods of analysis. Rapid methods are given in many cases, including the important elements sulphur, silicon, phosphorus, and manganese. The determination of carbon in iron and steel occupies 45 pages, including description of various apparatus needed. For those interested in the rarer minerals, the analysis of tungsten, vanadium, molybdenum, and chromium in steel is of value, also ferro-tungsten, ferro-molybdenum, ferro-vanadium, ferro-chrome, ferro-silicon, and ferro-manganese. Iron-ore analysis receives 43 pages, and is fully discussed; while fuel and fluxes in blast-furnace reduction are given due attention. A feature of the analytical work is a good sketch of nearly all apparatus used, a great aid in following each method. Generally, we consider this work timely and valuable.

Northwest Mines Handbook. Edited by Sidney Norman. Pp. 318, illustrated. Sidney Norman, Spokane, Washington, 1918. For sale by 'Mining and Scientific Press.' Price, $5.

The North-west, locally termed 'The Inland Empire,' contains a large number of important mines, mostly base-metal producers. The work before us is a reference of this region. Alphabetically arranged is given the capital, officials, property, development, and other details of 750 companies in Idaho, 300 in British Columbia, 300 in Washington, 130 in Montana, and 130 in Oregon, or a total of 1610. Preliminary to each State are statistics of its production and a brief chapter on its geology, the latter by some engineer of repute. In describing mines and company operations, commencement of each department is shown by bold-face type, but there is no paragraphing. For instance, the Bunker Hill & Sullivan occupies 2½ pages, but is one long paragraph. However, the matter is clear enough. Where possible, data are included up to April 1918. In Washington, the Stevens County copper and magnesite deposits, now attracting much attention, are described; also the Electric Point lead area. Only those properties in Montana in which Spokane people are interested are included, thus the big mines are not available. As a mining State, Oregon is frequently overlooked, so it is good to see its mines listed herein. In the description of the magnesite deposits of Washington, it is prophesied that as it costs $12.50 and under per ton to quarry and produce calcined ore in the northern State, and $18 to $25 in California, at a market-price of $20 per ton, California will probably be eliminated from the market. Two pages descriptive of Spokane, the centre of mining in the North-West, complete a handy compilation.

Safeguard the Gateways of Alaska: Her Waterways. By E. L. Jones. Special publication No. 50 of the U. S. Coast and Geodetic Survey, Washington, 1918.

This is a useful and well-illustrated publication.

Mining Decisions

Coal Land Entry—Single-Entry Limitation

Under Revised Statutes Section 2350 which authorizes but one coal entry by the same person, association or corporation, a corporation which received the benefit of an entry made by an individual, cannot make another entry, either itself or through an agent, even though both entries combined do not exceed the maximum area allowed by statute.

Union Coal and Coke Co. v. United States (Colorado), 247 Federal, 106.

Oil and Gas Lease—Forfeiture Clauses

An oil and gas lease containing a stipulation on the part of the lessee to commence operation on the premises within a year from a certain date or pay for delay, conferred on the lessee an option to drill or pay, and a failure to do either rendered the same forfeitable at the choice of the lessor. Where such a lease contains a clause reserving to the lessee the right at any time to remove all his property and re-convey the premises, and thereby render such lease null and void, it was held that a corresponding right existed in the lessor before development to compel a surrender.

Melton v. Cherokee Oil & Gas Co. (Oklahoma), 170 Pacific, 691. February 12, 1918.

Mining Corporation—Dissolution—Sale of Assets

When a majority of the stockholders of a mining corporation whose charter had expired, authorized a sale of all its properties to a new corporation, having the same directors, for a stock consideration, and minority stockholders objected to the sale as being for an inadequate price and not for cash, a showing that the properties had first been fairly and openly offered for sale at public auction to the highest cash bidder and that no bids were received, is enough to justify the action of the majority stockholders. They as well as the minority as entitled to protection.

Geddes v. Anaconda Copper Mining Co. (Montana), 245 Federal, 225.

Oil Lease—Separated Tracts—Failure to Drill on One

Two widely separated tracts of land were included under one oil lease which requires the lessee to drill within two years three wells "on the above described lands." The lessee drilled all the wells on one tract and did nothing with the other for more than ten years. Held, on suit to cancel the lease, brought by a subsequent owner of the second tract for failure of the lessee to drill wells thereon, that the Court's decree on the above state of facts should require the lessees to drill on said land within a reasonable time to be fixed by the Court, with a penalty of forfeiture if such work be not done within the decreed time.

Alford v. Dennis (Kansas), 170 Pacific, 1005.

Oil Placers—Exceptions from Withdrawal Order

Where contiguous oil-placer claims, not exceeding five in number, had been located by an association of eight persons, prior to the executive withdrawal of 1909, and development work had been prosecuted on one claim diligently and over $20,000 expended in preparations for drilling on the other claims, and the drilling in progress on one claim, as demonstrated by the subsequent discovery and extraction of oil, tended to develop the remaining claims, valid rights were vested in the locators that were not affected by the withdrawal order and were confirmed by the provisions of the Pickett Act, enacted by Congress June 25, 1910. Order of the trial court appointing a receiver reversed.

Consolidated Mutual Oil Co. v. United States (California), 245 Federal 521.

INDUSTRIAL PROGRESS

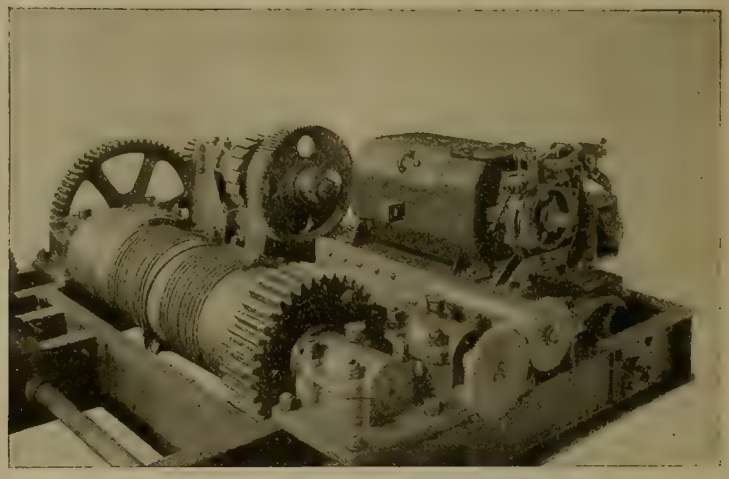
INFORMATION FURNISHED BY MANUFACTURERS

MAGNETIC BRAKES

The principle of the type of magnet which has been so successfully incorporated in the design of magnetic controllers by the Westinghouse Electric & Mfg Co., of East Pittsburgh, Pennsylvania, has been employed by that company in a new design of magnetic brakes developed for use with mill, crane, and hoist-motors. The use of a clapper-type magnet eliminates all moving parts within the coil and the consequent wear, sticking, or damage to insulation. The modified and improved 'type A' alternating-current brake with which the trade is already familiar and the new 'type B' direct-current brake are similar in operation and have common parts throughout except for the armature-lever and magnet. These brakes are characterized by the quickness of their operation. They respond almost instantly, releasing when the power is applied and setting when the power is cut off. This is due to the design of the operating magnet, which gives a high initial pull and a small distance of travel (¼ to 1 in.). Their operation is similar. When voltage is impressed on the motor the magnet is energized and the magnet-armature level overcomes the pressure of the compression springs through a toggle and releases the brake-shoe grip upon the brake-wheel. While the magnet remains energized the brake-wheel is allowed to rotate freely. As soon as the current is shut off from the motor the brake-magnet releases and the compression springs force the shoes against the brake-wheel, bringing the motor quickly and smoothly to rest without shock or jar. The compression exerted by the springs can be adjusted easily so that any holding or retarding torque up to the full capacity of the brake can be obtained for equal-braking effort for both directions of rotation. Simple means for making adjustment for shoe-wear are provided. In case adjustments for shoe-wear should be neglected a safety feature has been introduced so that the brake does not fail to hold the load, but the magnet will not release the grip on the brake-wheel. This insures proper brake-operation and the elimination of accidents due to the slippage of the brake-wheel. The simplicity and accessibility of the few parts of these brakes are shown in the accompanying illustrations. An interesting description, interspersed with many engravings, is given in the manufacturer's leaflets 1750 and 1751 on the types A and B brakes, respectively.



BRAKES AND BRAKE-WHEEL



MAGNETIC BRAKE APPLIED TO WINCH

The Ingersoll-Rand Co., 11 Broadway, New York, has recently issued the following new literature: Form 4039, 8-page bulletin on Leyner shank and bit punch for punching out holes in bits and shanks of hollow drill steel; form 901, 4-page flyer showing the complete line of 'Little David' pneumatic tools, with tables of sizes and capacities given and also illustrations showing all the tools and their applications; form 9028, 18-page catalog illustrating and describing equipment for sugar factory and refinery service, together with a separate Spanish edition available for those who desire it; form 9010, 4-page catalog on the 'Sergeant' ticket-cancelling box; form 901-1, a single-page flyer on the 'Little David' caulking machine; form 888, a 4-page flyer on the 'Little David' evaparator tube-cleaning and other labor-saving pneumatic tools; form 876, a single-page flyer on the Ingersoll-Rand barometric condensing plants; form 883-A, a single-page flyer on class 'FP' steam engines, horizontal centre-crank type with piston valves; and form 3015-1, 4-page bulletin on 'ER-1' portable mine car air-compressors.

COMMERCIAL PARAGRAPHS

The Emerald Coal & Coke Co., Pittsburgh, Pennsylvania, has increased its capital from $2,500,000 to $3,000,000 for expansion.

The Atlas Crucible Steel Co., Marine Bank Bdg., Buffalo, New York, has increased its capital from $1,500,000 to $3,000,000 for purposes of expansion.

The United Zinc Smelting Corporation, 99 John street, New York, operating at Moundsville, West Virginia, is drawing plans for the installation of a new furnace at its works.

The Mexican Mines Exploration Co., New York City, a Delaware corporation, has filed notice of increase in its capital stock from $200,000 to $500,000 to admit of proposed expansions.

The Maas & Waldstein Co., avenue R, Newark, New Jersey, will build a new nitrating plant at its chemical works. The structure will be two-story, about 56 by 126 ft., and is estimated to cost $30,000.

The Southern Manganese Mining Corporation, Birmingham, Alabama, has been organized to operate manganese properties in this district. Theodore Swann is president, and R. L. Ingalls, vice-president.

The Sutton Chemical Co., Sutton, West Virginia, is planning to construct a new chemical works on the Elk river to cost about $300,000. The plant will be used for the production of chemicals for the Government.

The War Department, Washington, D. C., has taken over the plant of the Charleston Alloy Steel Co., Belle, West Virginia, for a consideration of about $500,000, and proposes to re-build the works for the manufacture of chemicals for explosives.

The Alabama Co., 808 Union Trust Bdg., Baltimore, Maryland, Edward N. Rich, president, has acquired iron ore property at Gadsden, Alabama, and plans to undertake extensive development work. It is proposed to operate the mines with a monthly output of from 12,000 to 15,000 tons.

About 100 acres of coal lands will be developed by the **Dean Branch Coal Co.**, Bell Jellico, Kentucky, recently incorporated with a capital of $25,000. The company proposes to install a plant to provide a daily capacity of about 200 tons. W. B. Johnston is president, and A. W. Babbage, vice-president.

Lewis F. Shoemaker & Co., Pottstown, Pennsylvania, is considering extensions at its structural steel works to double the present capacity. The plant is devoting considerable of its output to the production of material for steel vessels for the Government shipyards, under the jurisdiction of the Emergency Fleet Corporation.

The Standard Spar Mining Co. of America, at Marion, Kentucky, recently incorporated with a capital of $500,000, is planning for the development of fluorspar properties consisting of about 100 acres. It is proposed to install an initial plant to provide for mining 100 tons daily. The plant will cost about $20,000. J. L. Oxley and Frank G. Fox are interested in the company.

The Aluminum Castings Co., Cleveland, Ohio, is having plans prepared for a new plant to be erected on Harvard avenue, near Thirty-second street, to cost about $400,000. The works will comprise a one and two-story structure, 100 by 200 ft., to form a foundry, pattern-shop, and other departments. A power-plant will also be erected. E. L. Allyns is president and general manager.

The Bull Creek Coal Co., Prestonburg, Kentucky, recently organized, is planning to install a complete coal-mining plant for the exploitation of about 500 acres of coal properties. It is proposed to reach an output of approximately 500 tons daily. The plant is to include mining equipment, boilers, engines, pumping machinery, and electrical power equipment. E. A. Layne is treasurer.

A new plant for the manufacture of marine boilers for Government vessels, to cost about $2,500,000, will be erected by the **Newport News Shipbuilding & Dry Dock Co.**, Newport News, Virginia, on a site selected on the James river. The plant will consist of machine shop, foundry, boiler works, riveting plant, and other structures, including an electric power-plant for operation. The new works is expexted to give employment to about 2000 men.

Electrical machinery, signal devices, and other equipment, to cost about $32,000,000 will be purchased by the **Interborough Rapid Transit Co.**, 165 Broadway, New York. The company has been granted permission by the Public Service Commission to issue bonds for $37,700,000 for extensions and betterments, including transmission system, $2,301,000; distributing system, $5,585,000; electric sub-station equipment, $3,870,000; new passenger cars, $7,581,000; electrical equipment for cars, $3,388,000; tunnels, $1,312,000; interlocking signals and other signal equipment, $3,371,000.

Two large ammunition plants for Government work are now in course of construction in New Jersey, at Morgan Station, near Perth Amboy, and near Mays Landing, respectively. The first is being erected by the **T. A. Gillespie Loading Co.**, and consists of a site of over 2000 acres, the bulk of which will be used for the works. Construction at this plant has reached a point where a few of the units are ready for operation, and a number of new units are being built. When under full operation, the works will give employment to about 5000 hands. The other plant, near Mays Landing, is being erected by the **Bethlehem Loading Co.**, Bethlehem, Pennsylvania, a subsidiary of the Bethlehem Steel Co. At this point work has been started on twelve units to form the main ammunition works. An electric power-plant will be constructed on a pile foundation for operating the works. The company also has arranged for a housing development, naming the village Belcoville.

Walter A. Zelnicker Supply Co., of St. Louis, has issued bulletin No. 237, listing a considerable amount of relaying rails ready for immediate delivery. The weights range from 100-lb. to 12-lb. rails. The firm also quotes crossings, frogs, switches, and other railway supplies, angle bars, girders, and a large assortment of second-hand quarry machinery. The list includes locomotives, large and small, electric locomotives, standard and narrow-gauge cars, gondolas, street cars, steam-shovels, both the railroad and traction type, and an unusually large assortment of air-compressors.

The American Smelting & Refining Co. is arranging for immediate erection of an addition to its works at Perth Amboy, New Jersey, to cost about $10,000. The company is operating the plant at capacity. Particular attention has recently been given to employees' welfare, and the construction of a large club-house for workers at the plant, to cost about $75,000, is under way.

The Blaw-Knox Co. announces its removal, on June 1, from the Rialto Bdg. to its new office and warehouse, 528-530 Second street, San Francisco. A quantity of steel forms for concrete construction, Blaw-Ransome concrete mixers, and Blaw clamshell buckets are carried in stock for immediate delivery.

Chas. Butters & Co., Ltd., 6400 Chabot Road, Oakland, California, will issue immediately a special catalogue describing the Jones-Belmont flotation machines. This apparatus affords high efficiency, and the catalogue will be of great interest to those who are interested in concentration of ores.